Of this issue more than 4000 copies were printed

The Welding Engineer

Vol. 1 | Chicago 220 S. State St. | FEBRUARY, 1916 | $2.00 per year in U. S. $2.50 per year abroad | No. 2

Keeping Pace With Progress

The high desire of mankind is to know the future, to foresee and forestall events. Having learned to associate cause and effect, we realize that tomorrow is born of today, that future progress is largely predetermined by present acts. We are borne upon the turbulent stream of events. Unable to stem the current, our great concern is to know its direction, our whole care to find the true channel. And this is called progress.

In every great field of industrial endeavor the trade press has become an institution without which progress would be retarded. The trade paper is a vehicle of communication, a medium for the intermingling of methods and of ideas. Because of the dissemination of practical knowledge the trade paper might well be termed "the melting pot" of any industry.

The founding of a trade paper in any field of endeavor usually marks the beginning of a new period, an era of progress and expansion. So we hope it may be in the welding field. Help us to bring this about. The Welding Engineer is the servant of the welding industry, a public utility in fact, and the writer extends to you an invitation to participate in its management.

Who Reads The Welding Engineer?

Four thousand of the livest and most progressive manufacturing industries, machine shops, ship builders, railroad and repair shops in America will read this issue. More than 1,000 had subscribed before the first issue, and at this writing the list has grown to more than 1,400. The remaining copies will, as they did last month, go to a selected list of desirable readers. The manufacturer of something to sell the welding trade can find no advertising medium which offers a better opportunity to reach this field. Particulars on application.

L. B. Mackenzie

*Alphabetical Index of Advertisers and Buyers' Index, Page 4.

The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

Oxweld Supplies are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

Write us for information on any class of Welding or Cutting Work

Oxweld Acetylene Company

CHICAGO
36th St. and Jasper Place

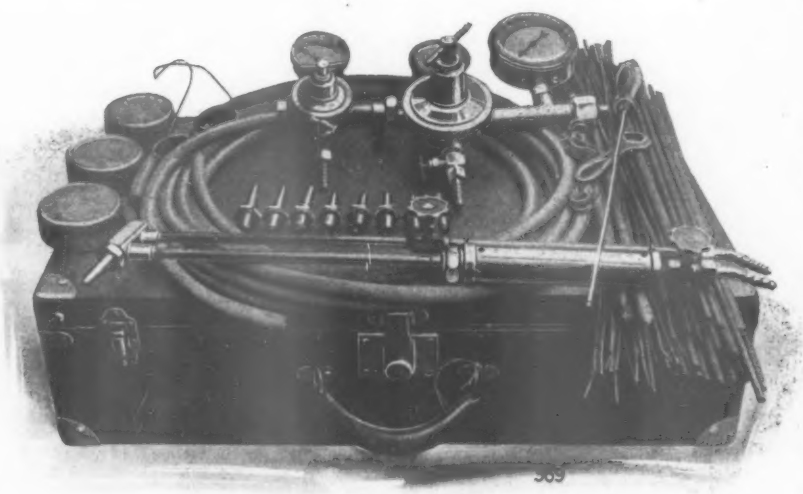
NEWARK, N. J.
6460-680 Frelinghuysen Ave.

LOS ANGELES
654-656 Pacific Electric Bldg.

The BUCKEYE Oxy-Acetylene Welding and Cutting Outfits

Stationary and Portable

We Build Preheating Kerosene Torches and Oil Furnaces



Live Men Wanted to Represent Us in Territory Not Allotted

Only Men Who Will Demonstrate Desired

We Build Both Oxygen as Well as Acetylene Generators

Ask for Catalog K

THE MACLEOD CO., East Pearl Street, CINCINNATI, OHIO

IMPERIAL WELDING AND CUTTING EQUIPMENT

OXY-ACETYLENE PROCESS

QUALITY

No. 1 Welding Outfit on Truck

Note These Big Features!

—features that no practical welder can overlook—features that mean *better work, great time saving and all-around economy*—are offered in Imperial Oxy-Acetylene Welding and Cutting Equipment.

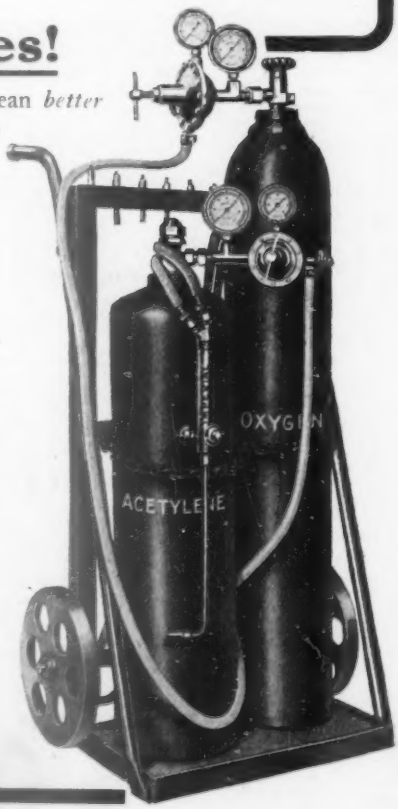
Safety Back-firing is the most dangerous drawback to most welding and cutting apparatus. Numerous rigorous tests prove that Imperial Equipment absolutely overcomes this vitally serious detriment, thus permitting the operator to work in a cool, confident attitude, with increased production as a result. Imperial Regulators have an automatic safety feature possessed by no other regulators.

Efficiency The Imperial Welding Torch produces a perfectly-mixed, accurated-regulated, long, white, incandescent flame—entirely free from carbons and oxides. Makes a quick, uniform, permanent weld.

The multi-jet Imperial Cutting Tips produce a closely confined, accurately proportioned jet that makes a clean, narrow, rapid cut through the thickest steel or wrought iron.

Economy No other equipment compares with Imperial in economical operation. Cheap equipment is practically wasted money—it is a voracious consumer of gas—short lived—produces inferior work—is often dangerous to use. Imperial torches produce the hottest flame—the best weld—at least consumption of gas.

Write for new catalogue, just off press, giving valuable operating data.



Imperial Brass Mfg. Co.

522 So. Racine Ave. CHICAGO

ALPHABETICAL INDEX TO ADVERTISEMENTS

A

Adams, William C. 12
Glasses, Goggles, Welders' Hoods, Etc.
American Carbolite Sales Co. 34
Calcium Carbide.

B

Bermo Welding Apparatus Co. 11
Oxy-Acetylene Apparatus and Supplies.

C

Campbell Iron Co. 33
Oxy-Acetylene Apparatus and Supplies.
Signal Co. 29
Chicago Eye Shield Co. 11
Goggles, Eye Shields, etc.
Commercial Acetylene Railway Light & Signal Co. 31
Compressed Acetylene in Cylinders.

D

Davis-Bournonville Co. 5
Acetylene Generators, Oxy-Acetylene Apparatus and Supplies.

G

Goldschmidt Thermit Co. ..... Back cover
The Thermit System of Welding Apparatus and Supplies.

H

Henderson-Willis Welding & Cutting Co. 12
Acetylene Generators, Oxy-Acetylene Apparatus and Supplies.

Imperial Brass Mfg. Co. 3
Oxy-Acetylene Apparatus and Supplies.
International Oxygen Co. 11
Oxygen and Hydrogen Generators.

L

Linde Air Products Co. 7
Compressed Oxygen in Cylinders. Distributng stations in forty cities.

M

Macleod Co., The 3
Acetylene Generators, Preheaters, Oxy-Acetylene Apparatus and Supplies.

O

Oxweld Acetylene Co. 2
Acetylene Generators, Oxy-Acetylene Apparatus and Supplies.

P

Prest-O-Lite Co., Inc. 14
Compressed Acetylene in Cylinders, Oxy-Acetylene Apparatus and Supplies.

S

Searchlight Co., The 8
Compressed Acetylene in Cylinders, Oxy-Acetylene Apparatus and Supplies.

T

Thomson Electric Welding Co. 1
Electric Resistance Welding Machines of All Types.
Toledo Electric Welder Co. 1
Electric Resistance Welding Machines of All Types.

U

Union Carbide Co. 1
Calcium Carbide.
Universal Oxygen Co. 1
Oxygen and Acetylene Generators, Welding Apparatus and Supplies.
U. S. Gauge Co. 1
Pressure Gauges.

V

Vulcan Process Co., Inc. 1
Acetylene Generators, Welding Apparatus and Supplies.

W

Westinghouse Electric & Mfg. Co. 9
Electric Welding Machines of All Types.
Welding Materials 12
Engineers, designers, selling agents welding machinery and supplies.

BUYERS' INDEX

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Railway Light & Signal Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.

ACETYLENE GENERATORS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
International Oxygen Co.
The Macleod Co.
Oxweld Acetylene Co.
Vulcan Process Co., Inc.

ALUMINUM FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Press Co.
Welding Materials.

ALUMINUM FLUX
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

ANNEALING FURNACES
The Macleod Co.
Universal Oxygen Co.

APRONS (Asbestos)
Welding Materials.

ARC WELDERS
(See Electric Arc Welding Outfits)

ASBESTOS GLOVES
Welding Materials.

ASBESTOS SHEET PAPER
Davis-Bournonville Co.
Oxweld Acetylene Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

BLOW TORCHES (Acetylene)
Bermo Welding Apparatus Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

BRASS SPELTER WIRE
Universal Oxygen Co.
Vulcan Process Co.

BRAZING OUTFITS
The Macleod Co.

BRONZE FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

BUTT WELDERS (Electric Resistance)
Thomson Electric Welding Co.
Welding Materials.

CARBIDE (Calcium)
American Carbolite Sales Co.
Union Carbide Co.

CARBON REMOVING OXYGEN
The Linde Air Products Co.
Universal Oxygen Co.

CARBON REMOVING TORCHES
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

CAST IRON FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

CAST IRON FLUX
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

CUTTING (Oxygen for)
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.

ELECTRIC RESISTANCE WELDING MACHINES
(See Spot, Butt and Seam Welders)
Thomson Electric Welding Co.

ELECTROLYTIC OXYGEN PLANTS
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

FILLER RODS (Bronze)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

FILLER RODS (Cast Iron)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FILLER RODS (Manganese Bronze)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FILLER RODS (Swedish Iron)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FILLER RODS (Tobin Bronze)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FILLER RODS (Vanadium Steel)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FIREPROOF PLASTIC BINDER
Welding Materials.

FLUE WELDERS (Electric Resistance)
Thomson Electric Welding Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
The Macleod Co.
Universal Oxygen Co.

FLUX (Aluminum)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

WELDING

OXY-ACETYLENE WELDING
DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO. N.Y.

CUTTING

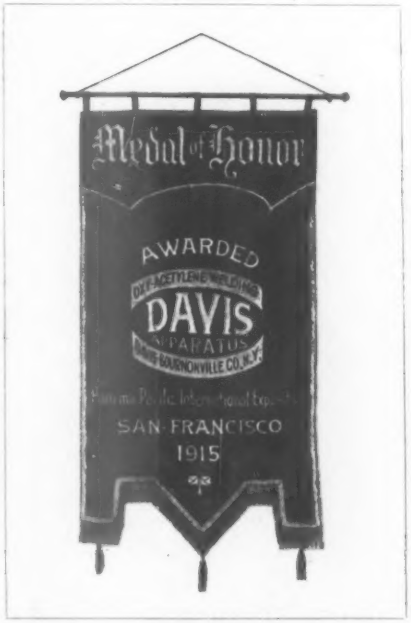
There is more Davis-Bournonville Apparatus in general use for oxy-acetylene welding and cutting than of any other.

It has been in general, practical use for welding and cutting longer than any other in this country.

It is being used by metal workers for a greater variety of operations in manufacturing metal goods.

The largest foundries and steel mills in the country are using it for reclaiming defective castings, welding, steel cutting.

The largest locomotive and car-building shops are using it for welding and cutting on construction and repair work.



The Medal of Honor (higher award than the Gold Medal), the Highest Award for Oxy-Acetylene Apparatus at the Panama-Pacific Exposition, was awarded Davis Apparatus.

The largest ship-building and dry docks and all United States Navy Yards are using it for steel cutting and repairs.

The largest range boiler and steel tank manufacturers are welding their product with it.

The largest steel furniture, door, sash and frame makers employ it in manufacturing.

The largest automobile metal-body builders are using it extensively for welding.

The largest scrap yards are using it for cutting and wrecking.

Hundreds of small repair shops and garages are daily making profitable use of small outfits.

Concerns that have made oxy-acetylene welding and cutting the big success it is, installed "D-B" apparatus because they gave efficiency of the apparatus and the value to be obtained from it first consideration in selecting equipment—because it provides the widest range of equipment made for obtaining the full value of the oxy-acetylene process—because the long practical experience of the "D-B" Company in its own welding shops and development and demonstration departments made it possible for the company to be of practical service to its customers.

These are reasons that will have weight with the prospective purchaser of welding and cutting equipment, whether his requirements are small or great.

Full information, catalogs, bulletins and co-operative service in determining the customer's application of the process will be given on request.

Davis-Bournonville Company

NEW YORK CHICAGO

Address General Offices and Demonstration Plant, JERSEY CITY, N. J.

Sales Offices: New York, Chicago, Detroit, Cleveland, Pittsburgh, Philadelphia

General Dealers in New England, Southern and Western States

FLUX (Brass and Bronze)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FLUX (Cast Iron)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

FLUX (Tobin Bronze)

GASOLINE PREHEATING FURNACES
The Prest-O-Lite Co., Inc.

GAS BURNERS (Preheating)
The Macleod Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

GENERATORS (Acetylene)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
International Oxygen Co.
The Macleod Co.
Oxweld Acetylene Co.
Vulcan Process Co.

GLOVES (Asbestos)
Welding Materials.

GOGGLES AND HOODS (Welders)
William C. Adams.
Bermo Welding Apparatus Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Westinghouse Electric & Mfg. Co.
Welding Materials.

GLOVES (Welders Asbestos)
Davis-Bournonville Co.
Oxweld Acetylene Co.
Universal Oxygen Co.

GAUGES (Pressure)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

HARDENING FURNACES
The Macleod Co.

HOSE (Oxygen and Acetylene)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

HOSE UNIONS
Bermo Welding Apparatus Co.

HYDROGEN
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Goldschmidt Thermit Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.

MANGANESE BRONZE FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding materials.

NEEDLE VALVES
Bermo Welding Apparatus Co.

OIL BURNERS (Preheating)
The Macleod Co.
Oxweld Acetylene Co.

OXYGEN (Compressed in Cylinders)
The Linde Air Products Co.
Universal Oxygen Co.

OXYGEN PLANTS (Electrolytic)
International Oxygen Co.
Universal Oxygen Co.

PIPE WELDING
Goldschmitt Thermit Co.

PHOTOGRAPHS
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

PLASTIC (Fireproof)
Welding materials.

PRESSURE GAUGES
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

REGULATING VALVES (Acetylene)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

REGULATING VALVES (Hydrogen)
Bermo Welding Apparatus Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Universal Oxygen Co.

REGULATING VALVES (Oxygen)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

SEAM WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

SEAM WELDERS (Electric Resistance)
Thomson Electric Welding Co.

SPELTER WIRE (Brass)

SPOT WELDERS (Electric Resistance)
Thomson Electric Welding Co.

SWEDISH IRON FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding materials.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)

THERMIT WELDING
Goldschmidt-Thermit Co.

TOBIN BRONZE FILLER RODS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

TORCHES (Gasoline and Kerosene Preheating)
The Macleod Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.
Vulcan Process Co.

TORCHES (Oxy-Acetylene Welding)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

TORCHES (Oxy-Hydrogen Cutting)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Universal Oxygen Co.
Vulcan Process Co.

TORCHES (Oxy-Hydrogen Welding)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Universal Oxygen Co.
Vulcan Process Co.

TORCHES (Special to Order)
Bermo Welding Apparatus Co.

TRUCKS (Cylinder Carriers)
Davis-Burnonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Universal Oxygen Co.
Vulcan Process Co.

VALVES (Acetylene Regulating)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

VALVES (For Acetylene Cylinders)
Commercial Acetylene Ry. Light & Signal Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.

VALVES (For Oxygen Cylinders)
International Oxygen Co.
Universal Oxygen Co.

VALVES (Hydrogen Regulating)
Bermo Welding Apparatus Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Universal Oxygen Co.

VALVES (Oxygen Regulating)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

Vanadium Steel Filler Rods
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

WELDING (Electric Resistance-Custom Work)
Thomson Electric Welding Co.

WELDERS' GOGGLES
William C. Adams.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.
Welding Materials.

WELDING MACHINES (Electric)
See Arc, Butt, Seam Welders.

WELDING (Oxygen for)
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Acetylene)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Macleod Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Searchlight Co.
Universal Oxygen Co.
Vulcan Process Co.

WELDING TORCHES (Oxy-Hydrogen)
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Universal Oxygen Co.
Vulcan Process Co.

LINDE OXYGEN

Service—Efficiency—Convenience—Economy

From Coast to Coast 39 Producing Plants and Distributing Stations provide an unlimited supply of LINDE OXYGEN for users everywhere.

PURITY

Linde Oxygen, made by the liquid-air process, is of the highest purity and efficiency. Exacting users demand Linde Oxygen, knowing they can obtain a uniformly pure gas, from a convenient source of supply, whether their requirements are large or small or vary from day to day.

SERVICE

Linde Oxygen is furnished in steel cylinders containing 100 and 200 cu. ft. respectively.

A large supply of charged cylinders is kept constantly on hand at all Distributing Stations, ready for immediate shipment.

LINDE SERVICE means no investment except for Oxygen actually received—no expensive overhead, or upkeep charges.

Linde Oxygen may be obtained direct from any of our Distributing Stations. Mail or 'phone your order to THE LINDE AIR PRODUCTS CO., at any of the following points:

ATLANTA, GA.
BALTIMORE, MD.
19 East Lombard Street
BIRMINGHAM, ALA.
10th Ave. and 16th St., North
BOSTON, MASS.
Address 241 Albany St., Cambridge, Mass.
BUFFALO, N. Y.
155 to 183 Chandler Street
CHATTANOOGA, TENN.
212-238 King Street
CHICAGO, ILL.
1501 So. Peoria Street
113 Austin Avenue
CINCINNATI, OHIO
63 Plum Street
CLEVELAND, OHIO
E. 73rd St. and Bittern Ave.
COLUMBUS, OHIO
310 Dublin Avenue
DAVENPORT, IOWA
118 Harrison Street
DAYTON, OHIO
521-523 E. First Street
DENVER, COLO.
16th and Glenarm Sts.
DETROIT, MICH.
St. Aubins Avenue
DULUTH, MINN.
7th Ave. W. and Railroad St.
EAST CHICAGO, IND.
EAST ST. LOUIS, ILL.
6th and Walnut Avenue
ELIZABETH, N. J.
EMERYVILLE, OAKLAND, CAL.
FORT WAYNE, IND.
414 East Columbia Street
INDIANAPOLIS, IND.
108 South Alabama Street
LOS ANGELES, CAL.
514-518 Molino Street
MILWAUKEE, WIS.
36th and National Aves.
MINNEAPOLIS, MINN.
500 North First Street
NEWARK, N. J. (Local Deliveries Only)
15-19 Division Street
NEW ORLEANS, LA.
861 Fulton Street
NEW YORK CITY
217 West 29th Street
NORRISTOWN, PA.
NORTH KANSAS CITY, MO.
OMAHA, NEB.
1007-9-11 Jones Street
PHILADELPHIA, PA.
18th and Cambria Streets
PITTSBURGH, PA.
25th St. and Allegheny R. R.
PORTLAND, ORE.
104 North Fifth Street
SAN FRANCISCO, CAL.
Kohl Building
SEATTLE, WASH.
530 First Avenue, South
ST. LOUIS, MO.
4218 Forest Park Boulevard
TRAFFORD, PA.
WORCESTER, MASS.
961 Southbridge Street

THE LINDE AIR PRODUCTS CO.

Forty-Second Street Building, - - - - - - - NEW YORK

LARGEST PRODUCERS OF OXYGEN IN THE WORLD.

Other Plants and Warehouses are planned for other industrial centers throughout the country and will be established as fast as and wherever the local demand for oxygen warrants.

The Difference

between

Dry and Wet Acetylene

and

Why it costs less to do a better job with Dry Acetylene than it does with Wet Acetylene

What Makes Acetylene Wet

Cylinders that contain acetylene for welding are completely filled with porous material. Some manufacturers use asbestos or a mixture of asbestos and cotton for this filling; the Searchlight Company uses a patented filler. Before the cylinder is charged with acetylene this porous filling is saturated with a liquid of an alcoholic nature which is called a solvent and which absorbs the acetylene and so makes it possible to insert a much larger quantity of the gas than the cylinder otherwise would contain. If this solvent escapes when the acetylene is released, the gas is "wet." That is to say, "wet acetylene" does not mean "wet with water," but "wet with solvent."

Why Wet Acetylene Makes Poor Welds

Dry acetylene burns at a temperature of about 7500° F. The solvent burns at a much lower temperature, and so reduces the temperature of the welding flame. The solvent does not flow evenly but collects in the tip of the torch in drops, and causes a sputtering and distortion of the flame and also makes it impossible to secure a proper mixture of oxygen and acetylene. For its highest-temperatured flame solvent requires about four times more oxygen than acetylene. If, therefore, the oxygen is adjusted to make a high-temperatured solvent flame, the weld is oxidized by the excess of oxygen when the solvent is not burning. If the oxygen is adjusted to secure a proper mixture with acetylene, the weld is carbonized by excess of acetylene while the solvent is burning. In either case it is impossible to get a correctly-mixed neutral flame.

The presence of solvent in the acetylene, therefore, means (1) a welding flame of low temperature, (2) a sputtering and irregular flame, (3) a flame that is either oxidizing or carbonizing and never is properly mixed. The result is that the efficiency of the welding flame is reduced from 50% to 60% by the presence of even a small amount of solvent in the flame.

What This Means to Welders

It is manifest, therefore, that it is of extreme importance to every welder to know the difference between dry and wet acetylene if he expects to save money in the use of gas and in the amount of time it takes to make welds, to say nothing of doing good work. In other words, the difference between dry and wet acetylene is something every expert welder must know and something every welder must know to become expert.

The patented filler used by the Searchlight Company makes Searchlight cylinders the only ones which will not release solvent. Use Searchlight acetylene beside any other acetylene and see for yourself.

The Searchlight Products

Besides manufacturing the only dry actylene on the market, the Searchlight Company is in the business of manufacturing and selling welding outfits. It sells the highest-grade, medium-priced outfit on the market. This outfit is equal in efficiency and workmanship to any high priced outfit. Don't take our word for it—ask the man who owns one.

Send for the folder "Dry *vs.* Wet Acetylene"

Searchlight Company

1040 Karpen Building -:- Chicago, Illinois

AN IMPORTANT BOOK

280 Pages 8vo. Cloth. 124 Illustrations

Net $2.00

Welding and Cutting Metals

By Aid of Gases or Electricity

By DR. L. A. GROTH, *Consulting Engineer*

CONTENTS.

General Remarks. Gases and Sources for their Generation. Welding. Blowpipes. Welding of Sheet Iron. Welding Applied to Steam Boilers. Cutting Metals. Reports Upon Acetylene Welding. Accidents. Legislation Relating to Calcic Carbide and Acetylene. Useful Addenda.

Welding by the various methods now practiced is associated with and dependent upon many different factors, all of which must be considered simultaneously to enable even the most skillful workman to produce satisfactory results. This general description, therefore, of the various and distinct methods, their suitability and selection for different operations, together with a collection of results and tests obtained, with the many illustrations given, should assist in the advance in technical knowledge and lead to the gradual accumulation of practical experience so necessary in every new industry.

THE WELDING ENGINEER

220 So. State St. Chicago, Illinois

221 Pages 5½x8¼ Inches 337 Illustrations NET $1.50

FORGING OF IRON AND STEEL

BY

WILLIAM ALLYN RICHARDS, B. S. in M. E.

Principal of the Grant Vocational High School, Cedar Rapids, Iowa. Fomerly Supervisor, Manual Training High School, Rockford, Ill., and Instructor in Forge, Foundry and Machine Practice in the University High School and University of Chicago, Chicago, Ill.

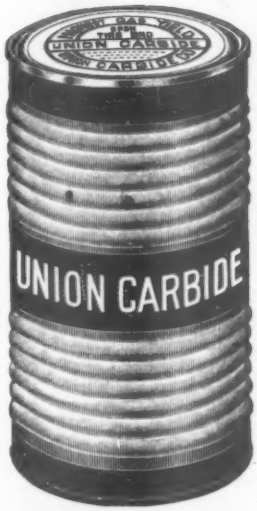
CONTENTS.

Chapter I. Introduction. II. Historic Use of Iron and Steel. III. Iron and Steel. IV. Equipment. V. Fuel and Fires. VI. Drawing Down and Upsetting. VII. Bending and Twisting. VIII. Splitting, Punching and Riveting IX. The Uses of Blacksmith's Tool. X. Welding. XI. Electric, Autogenous and Thermit Welding. XII. Brazing. XIII. Tool Steel. XIV. High Speed Tool Steel. XV. Art Iron Work. XVI. Steam and Power Hammers. XVII. Calculations. Appendix.

A simple treatment of the subject for the use of high-school classes, yet thorough and systematic enough to be a useful manual for the practicing smith. The work aims to elucidate the underlying principles of the subject, and in a series of review questions that close each chapter brings out the important phases of the various processes discussed. In an appendix the author presents a set of exercises, each of which exemplifies some principle of forgework, thus giving the teacher an opportunity to map out a course in the subject best suited to the equipment of the school.

THE WELDING ENGINEER

220 S. State St. CHICAGO



Packed in Blue and Gray Drums

Union Carbide Sales Company

Chicago, Ill., Peoples Gas Bldg., San Francisco, Kohl Bldg., New York City, 42nd St. Bldg.

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is always packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

"LUMP" —a large size, 3½ in. x 2 in.

"NUT" —an intermediate size, 1¼ in. x ⅜ in.

"EGG" —a medium size, 2 in. x ½ in.

"QUARTER" —finely crushed size, ¼ in. x 1-12 in.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

ALABAMA
Birmingham—1916 Morris Ave.
Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.

ARIZONA
Phoenix—16 S. Central Ave.

CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.

COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.

CONNECTICUT
Hartford—877 Main St.

DISTRICT OF COLUMBIA
Washington—Maryland Ave. & 9th St., S. W.

FLORIDA
Jacksonville—106 E. Forsyth St.

GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.

ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—123-147 W. Williams St.
East St. Louis—600 Walnut Av.
Marion—315 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.

INDIANA
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—921 Wabash Ave.

IOWA
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—925 Fourth St., P. O. Box 398.

KANSAS
Pittsburg—109 W. Third St.
Salina—103 S. Fifth St.
Wichita—721 Beacon Building.

KENTUCKY
Louisville—126 E. Main St.

LOUISIANA
New Orleans—715-717 Perdido St.

MAINE
Portland—202 Commericial St.

MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.

MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge "A."—Waverly St. and Putnam Ave.
Springfield—Napier St.

MICHIGAN
Detroit—Jefferson Ave. & Orleans St.
Grand Rapids—135 Ottawa Ave., N. W.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
Saginaw—1902 N. Michigan Ave.
Sault Ste. Marie.

MINNESOTA
Minneapolis—334 N. First St.
Virginia—413 Chestnut St.

MISSISSIPPI
Vicksburg—1312 Washington St.

MISSOURI
Kansas City—1316-1318 W. Eighth St.
St. Joseph—920 S. Sixth St., Sta. "A."
St. Louis—(See East St. Louis, Ill.)

NEBRASKA
Omaha—1007-9-11 Jones St., Union Sta. P. O.

NEW HAMPSHIRE
Concord—77 South Main St.

NEW JERSEY
Camden—Delaware Ave. & Cooper St.
Jersey City—554-56 Henderson St.

NEW YORK
Albany—108 Third Ave.
Binghamton—21 Jarvis St.
Geneva—Exchange St. and Railroad Pl.
Jamaica—11 New York Ave.
Kingston—O'Neil St., near Broadway.
New York City—42nd St. Building.
Niagara Falls.
Poughkeepsie—Smith St. & N. Y., N. H. & H. R. R. Tracks.
Utica—57 Hotel St.
Watertown—438 Court St.
Whitehall—57 Canal St.

NORTH CAROLINA
Wilmington—105 North Water St.

NORTH DAKOTA
Fargo—17-19 Broadway.

OHIO
Cincinnati—63-65 Plum St.
Cleveland—601 The Citizens' Building.
Columbus—310 Dublin Ave.
Dayton—812-828 E. First St.
Lima—338 East High St.
Toledo—414 S. Erie St.
Zanesville—Main and Second Sts.

OKLAHOMA
Oklahoma City—9-11 W. Main St.

OREGON
Portland—104 North 5th St.

PENNSYLVANIA
Beaver.
Du Bois—Weber Ave. and Franklin St.
Erie—1426 Chestnut St.
Harrisburg—627 Walnut St.
Johnstown—Messenger St. and B. & O. R. R.
Pittsburgh—32nd St. and Penn. R. R.
Pottsville—Railroad and Sanderson Sts.
Scranton—4 Cliff St.
Williamsport—Canal and Court Sts.

RHODE ISLAND
Providence—Allen's Ave., P. O. Box 419.

SOUTH CAROLINA
Charleston—153 Church St.

TENNESSEE
Chattanooga—700 E. Tenth St.
Knoxville—426 West Depot Ave.
Memphis—671 South Main St.
Nashville—105-107-109 Broadway.

TEXAS
Dallas—802-810 Cadiz St.
El Paso—900 Overland St.
Houston—Baker and Cedar Sts., Box 745.
San Antonio—Cor. Leal and N. Salado Sts.
Waco—633 S. 7th St.

UTAH
Salt Lake City—118 W. Second South St.

VIRGINIA
Lynchburg—1324 Commerce St.
Norfolk—513 Front St.
Richmond—18th and Cary Sts.

WEST VIRGINIA
Bluefield—195 Roanoke St.
Charleston—Broad St. and K. & M. R. R.
Fairmont—"A" Street
Huntington—820 3d Avenue.

WASHINGTON
Seattle—411 Globe Bldg., First Ave. and Madison St.
Spokane—646 Peyton Building.

WISCONSIN
La Crosse—Front and King Streets.
Madison—309 East Wilson St.
Milwaukee—120-134 Jefferson St.

We recommend our customers to **select** from the list, the **city** from which the quickest delivery and lowest freight rate can be obtained, **and address their orders to "Union Carbide Sales Company"** at the distributing point selected **accompanied by remittance.**

Please address request for information or special correspondence to either the Chicago or New York office.

Good Carbide

PROF. GEORGE GILBERT POND, of the Department of Chemistry, University of Pennsylvania, distinguished authority on Calcium Carbide, says:

¶ *"Present practice does, and future practice must, insist on purity of material. Good metallurgical coke, the analysis of whose ash shows only the merest trace of sulphur and phosphorus, is easily obtainable. This, with a reasonably pure lime, yields carbide of great purity, and there should be no other made."*

¶ This is the Ideal and the Endeavor in the manufacture of CARBOLITE, and is worthy both for ethical and economic reasons.

¶ Ethical because the consumer cannot tell, from appearance, the good from the poor; because he has no means of measuring the value as revealed in the gas yield. He *must* trust the maker.

¶ Economic because it costs as much, almost, to manufacture the poor as the good; the only saving, the imperfect fusion. Crushing, screening, and packing costs are the same. The details of ordering and selling are the same.

¶ Divergence begins with results. The same charge in the consumer's generator gives less gas, less satisfaction, there is more bother, more recharging, more removals of residue. And the imperfect fusion manifests itself in impure acetylene.

¶ This

TRADE Carbolite MARK

distinguishes *superior* from *inferior,* pure from impure, carbide, and stands for a definite, guaranteed gas yield.

American Carbolite Sales Company

Distributors

Duluth, Minnesota

MADE IN U. S. A.

Universal

UNIVERSAL OXYGEN COMPANY
SHEBOYGAN, WISCONSIN, U.S.A.

PURE OXYGEN and HYDROGEN GASES
WELDING and CUTTING EQUIPMENT
Milwaukee Branch: 315 Fourth Street

OXYGEN
and HYDROGEN
from an
I.O.C. SYSTEM
Plant

can be obtained at 1/3 price you are paying for these gases in cylinders. Each I. O. C. cell produces 4 cubic feet of Oxygen and 8 cubic feet of Hydrogen per KWH. The only raw materials necessary are distilled water and electric current.

Write for booklet

I. O. C. Single Unit Generator

Purity of Oxygen guaranteed 90% or better, and of Hydrogen 99.5% or better.

INTERNATIONAL OXYGEN COMPANY
General Sales Office: 115 Broadway, NEW YORK
Branch Office and Works, VERONA, PA. Works, NEWARK, N. J.

Welding Plants
for All Purposes
12 Sizes—Ranging in price from
$25.00 to $250.00

Write for catalog and our special 30 day offer.

A "BERMO" Plant means more profit for you.

Shipment made same day order received.
Liberal terms on plants if desired.

Address Department C.

Bermo Welding Apparatus Co.
Omaha, Nebraska, U. S. A.

The "CHICAGO" Welder's Safety Goggles

For Gas Cutting or Welding
For Electric Welding Apparatus
For Arc Welding Apparatus

No. 380—Price $1.00
Ventilated Sides Heavy Leather Nosepiece Elastic

Ask your jobber for either of these. He can supply you.

Lenses of any color or shade desired.

No. 500—Price $1.50
Fibre Frame an Absolute Non-Conductor of Heat

Manufactured by CHICAGO EYE-SHIELD CO., 134 So. Clinton St., CHICAGO, ILL.

WILLIS OXY-ACETYLENE APPARATUS WELDERS

"WILLIS" PRESSURE GENERATORS

"Willis" Pressure Generators are made in sizes of 50 pounds, 100 pounds, 200 pounds and 300 pounds capacity of carbide per charge.

The generator of 50 pounds capacity is standard for repair shops and light manufacturers, while the larger sizes provide an ample supply of gas for more extensive use.

The "Willis" Pressure Generators stand alone. The theoretical engineer and the practical welder proclaim their superiority. One of the important features to be considered in an acetylene generator is

Safety. We have made **safety** the first consideration, and how well we have succeeded is attested by the fact that we have never had an accident or explosion occur to any of our apparatus—a record held only by this Company. Our apparatus is as near "fool-proof" as it is possible for mechanical appliances to be.

The "Willis" Generators have independent power for feeding lump carbide and automatically starts and stops according to the pressure of the gas. These generators require no attention after being filled with carbide.

THE WELDING TORCH

Of equal importance to the Acetylene Generator is the welding torch itself. The "Willis" torch knows no equal. It is of the medium pressure type, and is known as the Constant Neutral Torch. The mixture of the gases is obtained in the head, and interchangeable tips of different capacity are provided to regulate the size of the flame.

Heads having different angles are furnished and are also interchangeable. This is a special patented feature of our torch and is found to be of great assistance to the operator. For ordinary bench work a torch having a head at about a 90 degree angle is most desired, while for boiler welding such as side, flue, or crown sheet work, a much greater angle than 90 degrees is preferable. These heads of different angles all fit the same torch. Another advantage which the "Willis" torches possess is that the heads rotate on the torch proper and are easily and quickly turned to any angle in the arc. For overhead work and certain other classes, this is of great assistance. These features give the torch preeminence as to facility. We guarantee our torch to procure as low a ratio of oxygen to acetylene as it is possible to obtain and maintain a neutral flame.

THE CUTTING TORCH

The Welding Torch can be easily and quickly transformed into a Cutting Torch by simply removing the Welding head and replacing same with the cutting attachment. This attachment connects with the oxygen supply for welding and only one oxygen hose is required. With this cutting torch it is possible to cut in any direction, as the oxygen jet always impinges on hot metal.

MANUFACTURED BY

The Henderson-Willis Welding and Cutting Co.

GENERAL OFFICE AND FACTORY

ST. LOUIS, MO., U. S. A.

Welding Machinery

Methods and Machinery Change Often

Do you know what we do?

Just as much attention is paid to your inquiry regarding an oxy-acetylene torch tip costing you 75 cents as if you were asking about one of those 80-A welders weighing 7,000 pounds and costing $5,000.00.

Why?

Just because that tip may be for a torch no longer manufactured, and may be very necessary to your business. Also because next year you may be in the market for an 80-A welder to weld 3-inch crank shafts.

We will send you a sample of welding flux just as cheerfully as we accept your order for a ton of cast iron welding rods.

An electric arc welder with a variable voltage generator at $800.00 may be best for your work. We will not try to sell you one at $1,200.00.

If a $30.00 oxy-acetylene welder will do your work we will tell you.

Write us mentioning "THE WELDING ENGINEER"

WELDING MATERIALS

Room 720, 115 So. Dearborn St. CHICAGO, ILL.

WELDERS' GOGGLE No. 3

White non-rusting metal, folding screens, all metal parts covered to prevent the frame from getting heated and burning the skin. Fastened on by an elastic headband.

No. 3. Mounted with first quality, gray green glass.....$1.50 each
Mounted with the new American Noviweld glass.....$2.00 each

Quantity prices upon application

This goggle is a great improvement over similar goggles on the market, the screens and frame are all made in one piece making it easy to insert new glasses. The frame is of heavy construction and the temples are fastened to the end piece with screws.

The above goggles furnished with light smoked, blue, amber or clear white glasses

WILLIAM C. ADAMS

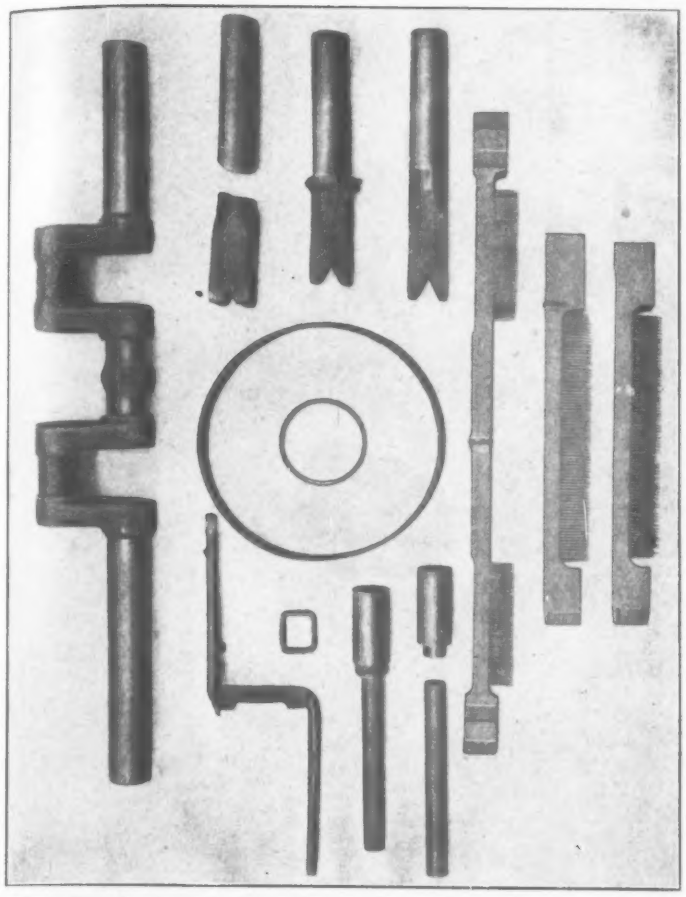
Manufacturer, Importer and Wholesale Dealer in

Welding Goggles and Protection Glasses

332 BOYLSTON STREET

BOSTON - - - MASS., U. S. A.

Write for Catalogue. Samples Submitted



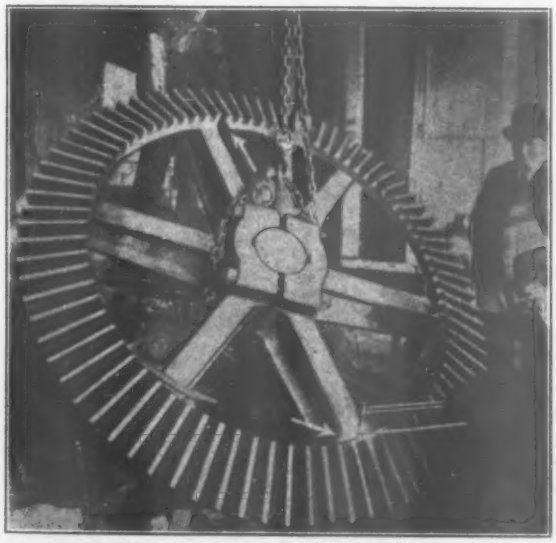
Welded crankshaft at left, stone cutting tools at top, wire ring in center and flat steel ring surrounding it, bicycle crank at bottom, small buckle, crucible steel plug welded to machine steel stem and fallers for combing wool. New ends have been added and weld made in center.

THOMSON
Electric Welders

There is great adaptability in Thomson Electric Welders. A glance at the group of articles illustrated here and which have been successfully butt welded will give some idea of the wide range of work which can be handled by Thomson machines. If you have a welding problem put it up to the **Pioneer Manufacturers.**

THOMSON ELECTRIC WELDING CO.

LYNN, MASSACHUSETTS, U. S. A.



This 4200 lb. gear was cracked in two places. Usually this means either the scrap heap or expensive repairs and a long tie-up. But here Vulcan did it in two hours.

The Vulcan Will Do It

Cracked castings of any description, broken frames, cylinder shafts or heavy forgings are saved with a

Vulcan Welding Outfit

It pays for itself in the time saved by eliminating long waits for renewals.

It permanently welds anything in metal.

Its range of work is surprising.

A Vulcan Weld Has Always Held

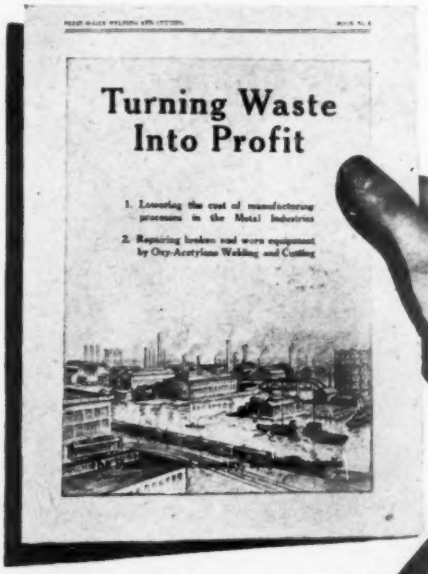
VULCAN PROCESS CO.

2445 University Ave. S. E., Minneapolis, Minn.

Here Is a Free Oxy-Acetylene Book You Ought to Have

Regardless of what welding process you are using—you should have the useful information that our engineers have collected for this book. Cold, hard facts about the savings that others are now making by this process.

Describes the simple, low-cost, general-purpose outfit—**applicable to every kind of welding job** that may come up in your shop.


Turning Waste
Into Profit
1. Lowering the cost of manufacturing processes in the Metal Industries
2. Repairing broken and worn equipment by Oxy-Acetylene Welding and Cutting

Full of helpful examples, illustrations of work done, instances of the kind of savings you can make.

Prest-O-Lite PROCESS

Employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite Dissolved Acetylene (ready-made carbide gas) is backed by Prest-O-Lite Service, which provides dry, purified gas, insuring better welds, quicker work and lower cost, and also avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

The necessary equipment is not expensive. We furnish high-grade welding apparatus for $60 (Canada, $75); acetylene service at additional cost. Also adaptable for oxy-acetylene cutting by the purchase of a special cutting blow-pipe. Thorough instructions are furnished free to every user—any average workman can learn the process quickly. We will train your operators at our shops if you desire.

Use the Coupon—Get Full Details

Right now—you may have a welding problem in manufacturing or repair work that the Prest-O-Lite Process will simplify, improve and reduce in cost.

The advice of our Engineering and Welding Departments is at the disposal of all users of Prest-O-Lite Process as often as they desire. Ask their help in solving your problems.

Every day you delay an investigation of the money-saving Prest-O-Lite Process you are losing certain profits.

WE:

THE PREST-O-LITE COMPANY, INC

Gentlemen:
I am interested in cutting costs and increasing quality in metal manufacturing and repairing.

Send me "TURNING WASTE INTO PROFIT."

Name .....

Address .....

With (Firm) .....

Have Used Welding: Yes..... No.....

The Prest-O-Lite Co., Inc.

The World's Largest Makers of Dissolved Acetylene

Main Offices and Factory
851 Speedway
Indianapolis, Indiana

Canadian Office and Factory
Merritton, Ontario

53 Branches and Charging Plants

The Welding Engineer

Published on the First Thursday of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
220 S. State St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor

Subscription payable in advance and postage free.
United States, Canada and Mexico.....$2.00 a year
Foreign Countries.....2.50 a year
Single copy, domestic.....20 cents
Single copy, foreign.....25 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the Act of March 3, 1879.

The Welding Engineer has made application for membership in the Audit Bureau of Circulations.

We guarantee that of this issue more than 4,000 copies were printed, excluding copies spoiled in press room and bindery. At the time of mailing the known distribution was (actual count always exceeds press order):

Copies to paid subscribers	1,423
Copies to advertisers	32
Copies to prospective advertisers	147
Copies to other trade papers, correspondents, etc.	10
Copies mailed as samples to prospective subscribers	2,288
Copies retained at office of publication to fill new subscription orders, etc.	100
Copies for office use	10
TOTAL	4,000

VOLUME I. FEBRUARY, 1916. NUMBER 2

Ethics of *The Welding Engineer*

1. To consider first the factor of safety. The Welding Engineer is unalterably opposed to the manufacture or sale of unsafe devices.
2. To consider and safeguard the interests of the subscriber.
3. To keep reading columns independent of advertising considerations and to measure all news by this standard: "Is it real news?"
4. To decline any advertisement which has a tendency to mislead or which does not conform to business integrity.
5. To solicit subscriptions and advertising solely upon the merits of the publication.
6. To supply advertisers with complete and reliable information regarding quality and character of circulation, including detailed circulation statements, subject to proper and authentic verification. The Welding Engineer, however, will not furnish or procure mailing lists for individuals or concerns for trade purposes.
7. To co-operate with all individuals and organizations in stimulating and extending the welding business.
8. To avoid unfair competition.
9. To determine what is the highest and largest function of the field and then to strive in every legitimate way to promote that function.

Questions and Answers

PRIOR to the publication of the first issue of The Welding Engineer we contemplated devoting considerable space each month to a "Questions and Answers" department. We had thought, however, that some time would elapse before sufficient material would come into our office to make this department interesting. It is therefore with a feeling of no little pride that we announce the beginning of the new department in this issue. Quite a number of letters have been received this month from readers and have been answered in this issue.

We believe a "Questions and Answers" department will serve a very useful purpose. We realize, and we believe the trade will realize, that it is going to be difficult to answer all questions to the entire satisfaction of everybody, but we are going to undertake to give our readers useful and unbiased information. When our published advice in a given case does not, in your opinion, offer the correct solution we wish you to feel that we will welcome a communication on the subject.

A Service to the Public

EVERY once in a while we hear of some spectacular piece of engineering work which interests some people and astonishes others. The manner in which the new Lake Street bridge in Chicago is going to be put into operation, for instance, is spectacular and very interesting. The work is described elsewhere in this issue and reflects great credit on the engineering ability of the contractors. Without the aid of oxy-acetylene cutting apparatus a part of Chicago's transportation system would be tied up for many days. It would be impossible to compute the saving effected to the citizens who use the transportation lines involved. When a man is asked in such cases to put a price on time lost in walking half way to work he is inclined to exaggerate. But the saving is by no means wholly represented in the figures of the contractors.

Prices of Supplies

MANUFACTURERS of welding rods, wires and fluxes seem to feel that prices are on the up-grade. One manufacturer of aluminum, for instance, states that no orders can be filled at this time. Many manufacturers of other materials, as well, are busy and in no position to fill orders promptly. It would appear reasonable to expect that jobbers of supplies will be obliged to raise prices gradually and if this is true, now is a good time to buy.

Welding at the Front

IT would be interesting to know what part welding is playing with the armies in war-stricken Europe. When the full story is known, when European mechanics have laid down their arms and returned to peaceful vocations, then we shall learn to what useful tasks welding processes were assigned. We do know that in wrecking work, such as clearing away wrecked bridges, etc., oxy-acetylene cutting apparatus has been extensively used. But in the factories and munitions plants behind the lines production and efficiency is the watchword and welding processes must be a big factor.

Letters from the Trade

IF you are welding in your plant by some one of the various processes we are interested in your work. We would like to know what you weld and how—in fact, our readers want to know all about it. Photographs illuminate a description of welding work, but line drawings as illustrations are even better. Make a rough pencil sketch of the job and from it we will make a finished drawing. When you do a piece of work of which you are proud tell us all about it. In doing so you will be contributing to the welfare of the entire industry.

Helping the Welder Make Good

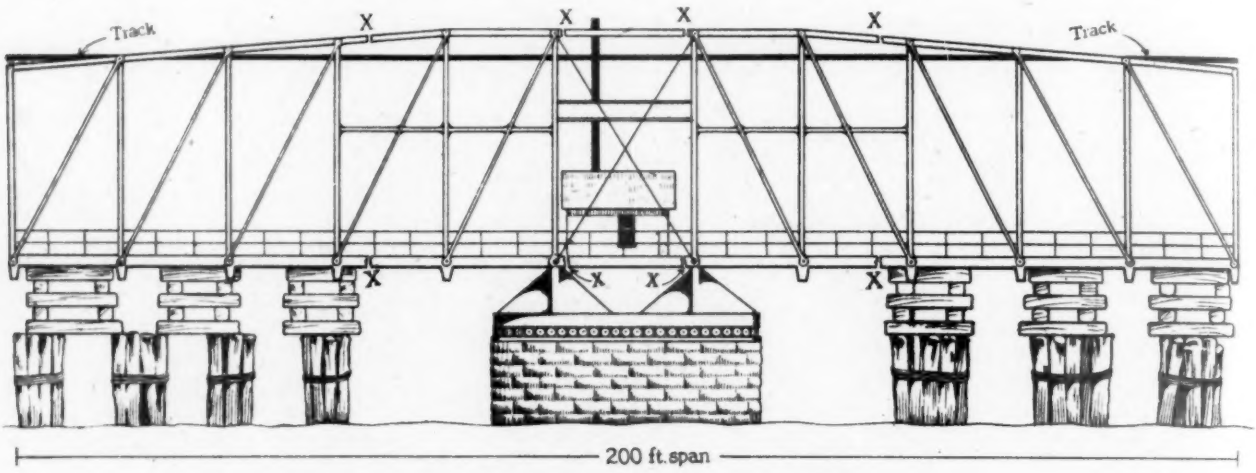
THE manufacturer of any product which is sold over the counter at retail is obliged to study retail methods and conditions closely. In fact he must not only make a good article at a fair figure, but he is also obliged to show his retailer customer, the storekeeper, how to move the goods. A large proportion of the users of oxy-acetylene welding apparatus are what might be termed "job welders", that is to say they are soliciting work from the public. The manufacturer of apparatus and supplies who can show these customers how to bring work into the shop will be serving their own best interests.

An Interesting Bridge Wrecking Problem

In Thirty Minutes a Bridge Which Has Handled a Big Daily Traffic Will Be Cut Away by the Oxy-acetelene Method.

While elevated trains of the Chicago and Oak Park Elevated Railroad have been running at intervals of from one and one-half to six minutes every day over the Lake street bridge over the Chicago River, a new bridge has been erected and is ready to take its place.

The accompanying sketch shows the manner in which the old swing bridge is to be wrecked by the oxy-acetylene cutters. After the old swing bridge has been swung lengthwise of the channel of the river so that navigation need not be suspended, the two ends, both of a length of 65 feet will be



The bridge will be cut at points marked "X"

On February 19th, 1916, perhaps while some of our readers are reading this article, the new bridge will take the place of the old.

Oxy-acetylene cutting torches will cut off the sections of the old bridge, the two leaves of the new rolling lift bridge will drop into place and traffic will go on as if nothing had happened.

The photographs accompanying this article show clearly the old double deck swing bridge, slow, a menace to navigation and years ago condemned by the United States government, and the new bridge of the latest design, in place above the old, waiting for the schedule time, set over a year ago, when it is to drop into the place occupied until the last moment by the old one.

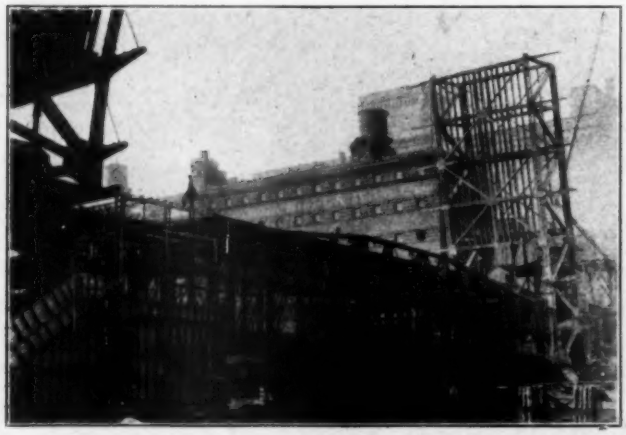
The work of building the new and wrecking the old bridges is being done by the Kettler-Elliott Erecting Company of Chicago. This firm owns and operates its own cutting apparatus, using tanked oxygen and acetylene on account of their portability.

cut and allowed to drop on the piling and false work shown in the illustration.

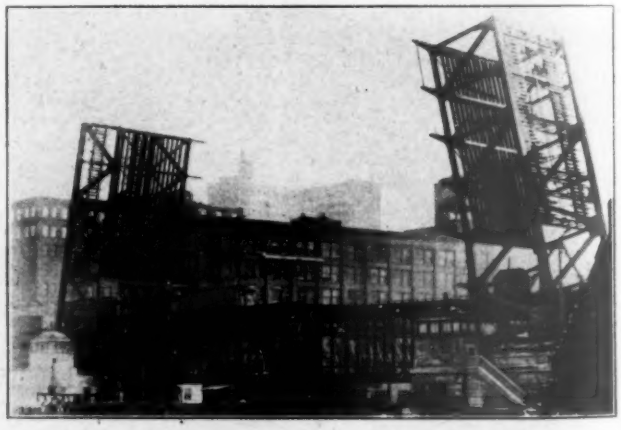
The center part of the structure is then to be cut on either side of the center tower on which it turns, as indicated by crosses in the illustration. These three sections will then be lifted out by powerful derricks on to barges, which will be towed downstream out of the way.

The motors of the new bridge will then be started and the two leaves of the new structure will be dropped into place ready for traffic both by the surface street cars, wagons and pedestrians on the lower level and by the elevated trains of the Chicago and Oak Park Elevated Railroad on the upper tracks.

The new bridge being of the lift type, allowed the building of the two new spans, complete in every detail, while the traffic across the old bridge was still going on. The removal of the three center sections will allow the dropping of the new bridge into place. The two larger end sections will be allowed to rest on the piling and false work shown in the illustration until the rest of the work has been completed.



The new bridge was built while the old one was in operation



The tracks are even in place on the new bridge

The work has been a triumph of engineering for the Kettler-Elliott Construction Company, in the handling of the traffic problem. In the matter of getting the old structure out of the way, due credit must be given to the use of the oxy-acetylene cutting torches, which this firm uses on nearly all its heavy construction jobs.

In the original plans the use of the oxy-acetylene cutting torches was taken into consideration and the date of February 19, 1916, several years off, was set, as the day on which the big 200-foot span weighing over 800 tons would be dismembered in a day to make way for the modern bridge, which in the photographs stands ready to take its place.

This is the position the old bridge will be in when the cutting begins

It may interest some of our readers who handle cutting contracts to know that in the cutting estimates, due recognizance was taken of the presence of rust and scale on the old steel structure and that due preparations were made for the proper scaling along the paths the oxy-acetylene cutting torches will take.

Again this process has demonstrated its efficiency, cutting weeks to days and hours to minutes. The dependence of steel contractors and workers on this method and its efficiency are the result of the proved dependability of the process.

WELDING AND CUTTING IN FOUNDRIES

By J. R. Wilson
Davis-Bouronville Company

In gray iron and steel foundries, the process is extensively employed in the reclamation of castings which come from the molds with blow holes and cold shuts. Before this system of welding was placed in use, castings with small defects, such as mentioned above, were necessarily scrapped, whereas under present conditions they are reclaimed at a very slight cost.

In addition to the welding of defective castings, steel foundries find the process invaluable for cutting risers. Formerly various methods were employed to remove these risers, the principal methods being to knock them off with a sledge, resulting in a very uneven surface being left, or by sawing them, with the result that considerable stock was left to be ground off later. The latter method was also very difficult of accomplishment, due to the very irregular shapes of many of the risers, making it almost impossible to get them in the saw properly. With the oxy-acetylene cutting torch, such difficulties are entirely overcome, inasmuch as the torch can be placed in various positions most convenient for the handling of the casting.

In the sheet metal industry, the process is employed extensively in the welding of steel barrels, tanks, metal furniture, boilers and many other sheet metal products, in all instances superseding the former method of riveting. This not only results in a much more substantial joint, but is accomplished at considerably less cost.

Automatic welding and cutting machines have also been developed, which assist materially in the handling of various manufacturing work; for instance, the barrel welding machine by which welds are made, both inside and out of the shell simultaneously, tube welding machines for the welding of the commercial steel tube; the Holograph for cutting holes in the web of rails or in structural iron, the Radiagraph for the purpose of cutting plates or sheets into round, oval or irregular forms, the Railagraph, for cutting the rails of steam or electric railways, or all kinds of forms in structural work, and the Oxygraph, a machine having an electrically propelled roller tracer, which can be guided along the lines of a drawing and the cutting flame making an exact reproduction of one-half the dimensions.

GENERAL INFORMATION

Expansion and Contraction

One of the greatest obstacles to success in welding by the Oxy-Acetylene Process, is the expansion and contraction of metals. While this difficulty pertains to every method of welding, it is more likely not to be regarded with sufficient importance in the Oxy-Acetylene Welding Process, because it frequently happens that the operator is not familiar with the conditions governing expansion and contraction, as is more apt to be the case with operators employing the longer established methods. It is not only easy to produce, but it is often difficult to prevent, strains caused by welding that will fracture the metal when it is cooled. This is particularly likely to be the case when some portion of the metal is very thin, and others thick. While the internal strain may not be sufficient to crack the metal, it can still be great enough to cause it to break when the ordinary working strain is added.

Preheating

Usually, it is advisable to preheat metals of considerable weight or thickness, especially cast-metals, before welding. This not only equalizes the internal strain, but very materially reduces the cost, as the weld can be made more quickly, and there is a much smaller consumption of gases, than if the weld had been made by the Oxy-Acetylene flame alone. This preheating can be accomplished in a gas furnace, or with an oil torch by surrounding the article to be welded with fire brick, or by means of charcoal, the latter being preferable for Aluminum work. When the metal has been preheated, sheets of asbestos paper can be placed over it to protest the operator, and prevent heat radiation, of course leaving the portions to be welded exposed to the welding flame. When the weld is completed, the Torch-flame should be passed over the weld, and the portions adjacent thereto, until the point where the last part of the weld has been made becomes of the same color as the surrounding metal. The whole metal should then be covered and allowed to cool slowly, drafts of cold air being most carefully avoided, except where a straight weld is to be made, and the preheating flame is used only to reduce the time of operation, and save the Oxy-Acetylene gases, and not to overcome expansion and contraction; the flame should never be directed against the weld itself, but the heat from the same should be evenly distributed, if possible, so that the article to be welded will be heated uniformly throughout.

Expand Before Welding

It cannot be too strongly impressed upon the operator that it is far better to produce expansion before welding, if possible, than to attempt to care for the contraction afterward. Where there is a straight crack, it can usually be opened uniformly by heating the metal at each end, and keeping it hot while the weld is being made, when it will be found that the contraction caused by cooling has been provided for.

Where a piece of metal has been broken squarely in two, or a projection has been broken off, preheating will not be necessary, unless in heavy welds, where it is desirable to reduce the time of operation, and save the consumption of gases.

Never add metal with the welding stick, or wire, before the part to be welded is itself in fusion, and always have the welding stick in contact with or close to the welded metal, while adding the same to the weld.

In heavy welding, the parts to be welded must be brought to a red heat for a distance of, say three times its thickness on each side of the weld up to 1 inch in thickness, increasing the distance reasonably as the weld exceeds this thickness.

Spots in Welding

In heavy welding, it frequently occurs that there is a spot in the middle of a weld where the metal refuses to flow. The cause is that the metal to be welded is not hot enough surrounding this spot; the heat being radiated by the cold metal, consequently the added metal is chilled. The remedy is to play the flame in a radius of from ½ to 1 inch around the refractory point until the surrounding metal is at a white heat, then apply the flame to the spot itself, and it will quickly unite with the other molten metal. In welding two pieces of metal together, care must be taken not to heat one more than the other, for if this is done the hottest piece will expand most and consequently may be longer, or the work may be thrown out of alignment, or the weld may crack in cooling, because of uneven contraction. This is more particularly applicable in cases where pieces are welded at sharp angles.

Proper Sized Flames

Do not use too small a torch for the thickness of metal to be welded, because in such case the heat will be radiated almost as fast as produced, and the flame will have to be held at one point so long before the weld can be accomplished, that the metal will be burned. Furthermore, it will take much longer to make the weld, and a much greater consumption of gases to do the work.

Too large a flame is equally bad, because the radiation will not be sufficient to lower the 6,300 degree F. flame where it will not burn the metal which is already in a molten state. The proper flame will reduce the metal to a plastic molten condition, not too fluid, and of a width about equal to the thickness of the metal welded.

When welding heavy metal, be very careful not to blow a part of the molten metal on to a portion of the weld that is not in fusion, as it will make a defective weld at that point. If this should occur, do not fail to pass the flame over this chilled portion until it is again in fusion with the molten metal of the weld.

Cast Iron

If the piece to be welded is of such form that it will crack in cooling, it should be preheated, but not sufficiently to warp the metal, no part to be brought to a dark red except at the welding point. Charcoal is a good material to preheat with, as the heat is uniform and not excessive. The base of a blacksmith's forge, in connection with a sheet iron hood, can be used to good advantage. Another method of preheating is to have a fire-resisting table and to build up around the piece with brick in such a manner as to cause the heat to be confined and distributed evenly, leaving an opening through which an oil or gasoline torch-flame, or a gas flame, can be used. Of course, a heating oven is also convenient for this purpose. Whether the metal is preheated, or not, it should always be covered immediately after the weld is finished, and allowed to cool slowly. Some operators use slaked-lime or very dry sand in which to bury the parts until they cool, but where the conditions will permit it is better to allow them to cool in the positions in which they were preheated.

There are many pieces of cast iron that can be welded without preheating, but where it is convenient to do so, it is advisable to preheat.

If the metal is more than ¼ inch in thickness, the edges should be chipped or chamfered to a beveled form of 45 degrees on each side. In the heavier welds, it is desirable to leave three slight points of contact to assist in adjusting and holding the broken parts in their exact original position, while welding.

To make the weld, the Torch should be passed for some distance around the fracture, and then directed on to the fracture until the metal becomes a cherry red. When this occurs, have an assistant throw on a little scaling powder and when the metal begins to run, add cast iron from a cast iron welding stick. Powder should only be added when the metal does not flow well, but do not add too much and finish with as little powder as possible, as an excess will tend to make the iron hard.

Much ingenuity can be used in overcoming the bad results of expansion and contraction, and in making repairs that might at first have appeared impossible. For instance, in welding the crown of the inside of an automobile cylinder, a piece can be cut from the outer shell of the water jacket, the crack repaired, and the piece which was removed welded into place.

Never attempt to reweld pieces that have been previously welded, or brazed, without cutting away all of the old metal.

Steel

Steel of ⅛ inch and less in thickness, can be welded without the addition of any welding metal. Thicker metal should be bevelled or chamfered.

In welding steel, remember that the welding material should never be added until the edges of the metal to be welded are fused, or molten, at the place where the weld is being made. The welding metal should be of special wire, and in no case should the flame be held on to the weld until a foam is produced, as such foam is an indication that the metal is being burned.

In adding metal to the weld, hold the added metal so that it touches or is close to the metal to be welded. This enables the heat to be radiated from the welding metal rods to the body of the metal to be welded, whereas if the welding metal is allowed to drop through the welding flame, it probably would be burned to an injurious extent. Do not hold the flame steadily in the center of the weld, but use a circular motion with an uplifting movement in each revolution, always driving the molten metal toward the center of the weld.

In welding a crack in the middle of a heavy steel sheet, prepare the crack by chamfering the metal on each side of the same at an angle of 45 degrees to the bottom, then as previously directed, apply the welding torch to the metal beyond the end of the crack until it is expanded enough to open the crack perceptibly and make the weld while the metal is in this condition, and usually it will be found that the expansion has been sufficient to care for the contraction in the weld when cooling.

UNIQUE ALUMINUM WELDING

The container shown in the illustration is a product made for some years by the Chicago Aluminum Castings Company of Chicago.

This container is cast from aluminum and measures practically nine inches in length, six inches in breadth and three inches in depth. It is closed on all sides excepting for two one-inch spouts threaded for screw caps, one on either end.

The casting which was only three-thirty-seconds in thickness often contained blow-holes, unobservable until the process of grinding and polishing down the surface had progressed to a point where the labor already expended had a value which made quite an item in the cost.

Although no oxy-acetylene welder had ever made a successful weld owing to the fact that if preheated, the casting warped, and if welded cold, it surely cracked; the agency selected by the engineering department of "Welding Materials" was that of oxy-acetylene.

The method which was demonstrated and was successful from the very first was very simple and was performed by Mr. H. E. Horton, one of the members of the firm on the second trial and has been in constant use ever since.

A very small neutral flame from an especially made tip

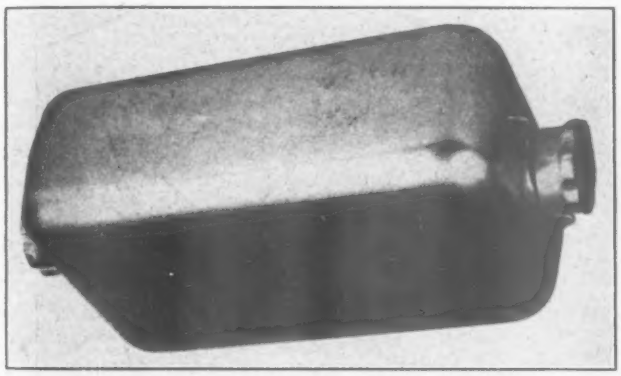
with a very small flame is played on the cold casting, the operator being very careful to keep the heat on the flaw as short a time as possible and as concentrated as possible to avoid the radiation of heat to the parts surrounding. Although the metal surrounding the flaw is not yet molten, enough aluminum from the welding rod is dropped on the flaw and the welding flame immediately removed.

The casting now again goes to the finisher who grinds and dresses the weld and finishes the process of buffing and polishing which had been interrupted to remedy the flaw.

The process was explained to The Welding Engineer by Mr. H. E. Horton, a member of the firm in the following statement:

"When I was connected with a Detroit foundry, we often repaired an automobile casting which showed a cold short or flaw in coming out of the sand. We burned it in, as it was called or poured melted aluminum into and over the flaw and then dressed it off. The heat of the added metal brought the edges of the flaw to such a heat as to combine them together. This method saved a lot of expense as it is well known that in recasting aluminum shows a loss in bulk of anywhere from 12 to 25 per cent, besides the loss of all the labor used up in finishing up to the point where the flaw is discovered.

"This labor is usually considerable as the grinder and polisher usually find that the flaw is in the shape of a cone with the point towards the outside of the casting and the base towards the core. The result is that the deeper the casting is ground or polished the larger the cavity. Thus it is that the flaw is sometimes discovered just as the finishing touches are being given the article, and all the labor has been wasted



An aluminum container welded by oxy-acetylene process

unless the article can be reclaimed through the welding process as we are doing.

"The flaws are never more than a quarter or three-eighths inch in diameter, the cost of oxygen and acetylene usually less than one cent per operation and the saving per article from ten to thirty cents each. Any mixture of welding rod which is elastic and soft can be used. No flux is used. The time of the operation never exceeds a minute, often only consuming a few seconds."

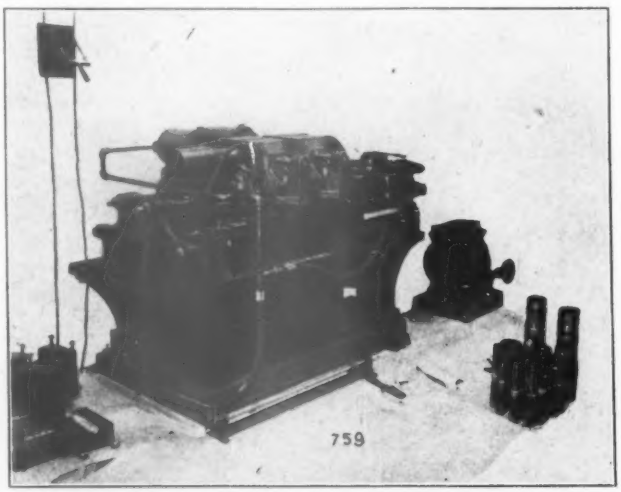
WELDING SUPERHEATER TUBES

The ilustration shows a 60-K.W. "Thomson" electric resistance machine with air operated clamps, for welding superheater tubes up to 5½ inches diameter.

Pressure is applied by the twelve-ton double acting oil jack mounted on the right and operated by the lever shown at the front. The secondary is of a single turn of cast copper weighing nearly eleven hundred pounds. The whole clamping device is of gun metal mounted on gun metal platens and all water cooled (shown by piping and rubber hose). The breakswitch is mounted on the left and operated by treadle. The reactive coil at the right is required when welding sections smaller than the normal capacity of machine.

A 5½-inch superheater tube is shown in the clamps. Water cooled copper electrodes for different diameters of tubes and welded tubes are also shown. The machine with reactive coil can be used for standard pipe ¾ inch to 4½ inches; extra strong ¾ inch to 3½ inches; double extra strong ⅜ inch to 2½ inches and boiler tubes 1 inch to 5½ inches.

For welding tubing it is customary to use electrodes bored out to fit each size, but in standard and other pipe the elec-



60-K. W. "Thomson" Electric Resistance Machine for welding super-heater tubes

trodes are made with a "V" on one side to locate the pipe. giving three points of contact only, or with both electrodes notches in this manner, giving four points of contact. Plain solid rounds from ⅝ inch to 2¼ inches, squares from 9-16 inch to 2 inches, and flats also from ¾ inch to 4 inches can be welded in the machine. With solid stock "V" electrodes are used; with flat stock, flat electrodes.

The machine should be supplied from a 90-K. V. A., 40 to 60-cycle alternating current, single phase, or may be wired from one phase of a multi-phase circuit, and can be adapted for any pressure between 100 to 600 volts.

Four-inch tubes take about 30 seconds to heat; allowing 45 seconds to handle the tubes, clamp and unclamp them and be ready for the next weld, fifty welds can be made per hour; smaller tubing takes less and larger, more time to heat.

The machine is very popular with manufacturers of pipe coils and the railroads are also using it for safe ending boiler tubes and for superheater tubes. The clamping device adapts itself as well to the welding of rounds, squares and flats, and makes the machine useful for a great variety of work—for instance, the welding of carbon and high speed steels for shaper, lathe and planer tools is, in these day of high cost of such materials, a great advantage to those who use them in large quantities.

The machine weighs about 8,000 pounds, with a floor space of about 100x60 inches and is made by the Thomson Electric Welding Company of Lynn, Mass.

IMPERIAL ISSUE CATALOG

Catalog No. 132 has just been issued by the Imperial Brass Manufacturing Company, 522 S. Racine Avenue, Chicago, which described the Oxy-Acetylene apparatus manufactured by this company. The book contains a general preface on Oxy-Acetylene welding and cutting together with a general description of apparatus, welding, torches and cutting attachments of various kinds, oxygen and acetylene regulators, trucks, welding outfits, combination welding and cutting and decarbonizing outfits, accessories, welding rods, fluxes, welder's goggles, hose, etc. The catalog is very highly illustrated, and will prove very interesting to the trade.

A CONTINUOUS PIPE WELDING MACHINE

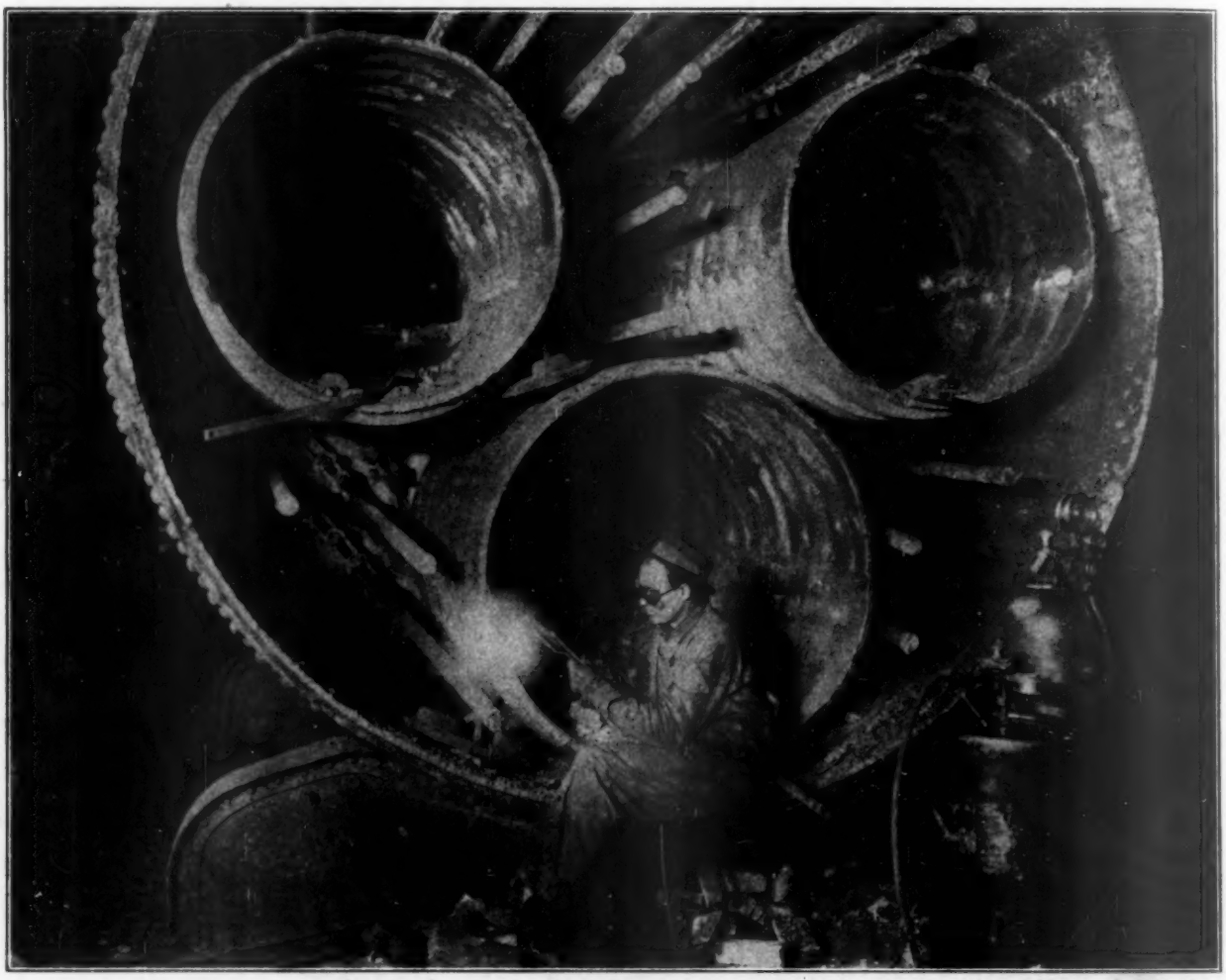
Light gauge steel tubing is being manufactured in the plant of the Elyria Iron & Steel Company, Cleveland, by the Oxy-Acetylene process. This is possible through the development of a continuous tube welding machine, which is automatic in operation. As described in The Iron Age for January 13th the process is as follows:

Strip steel enters the machine, is formed into tubing, welded by a stationary welding torch as it passes under the the machine in the form of finished product. By this method flame and is automatically cut to length as it passes out of tubing can be made of any length. As the only physical strain put upon the steel in the process of making the tubing is that of forming it, no drawing, annealing or pickling is required to restore properties lost in the process of manufacture.

The strip steel stock as it first enters the machine from a coil passes through six sets of forming rolls. On leaving the last set of rolls the tube is formed to shape, the two edges coming into close contact on the upper side but not overlapping. Just beyond the last set of rolls is located a fixed, continuous welding torch which welds the joint. The joint is fused without the use of wire or other filling material. While being welded the tube is held in an adjustable welding vise composed of two endless chains that revolve as the tube passes through. The vise holds the edges of the joint firmly together until they have welded and cooled. The jaws of the vise are oval-shaped and so formed that they bear on the sides of the tubing. They are sufficiently far apart not to interfere with the flame from the torch. No power is applied to the endless chain vise, its rotary motion being effected by the forward movement of the tubing which it grips. The vise revolves around an oval-shaped circulating water chamber, and this cools the metal sufficiently to cause the weld to hold before the vise releases its grip. After leaving the vise the tube is further cooled by passing under a jet of water and the burr is then ground off the welded joint by a Norton grinding wheel which is a part of the machine. The tube then goes through three additional sets of rolls, these being for finishing to size and straightening. Between the grinding wheel and the finishing rolls is an endless chain pulling device which grips the tube and keeps it moving at the proper speed while it is being formed and welded.

The finished tube runs on to a cut-off trough in which it is automatically cut to standard lengths or to specifications. After a section of tubing is cut off the trough automatically drops and allows the piece to roll off into the stock pile of finished tubing. The cutting is done by a shear blade, operated by a cam that is set in motion when the tubing, as it moves along the cut-off trough, comes in contact with a stop on this trough. The cutting device moves with the tubing a short distance during the cutting operation, and after cutting the tube it automatically moves back to its regular position on the machine.

The stock used for the manufacture of the tubing is mostly cold rolled strip steel, although some hot rolled stock is used. The steel is from 16 to 20 gauge inclusive, and the tubing is made in sizes from ½ to 4 in. diameter. The stock is re-



Fourteen marine boilers were cut up for loading into cars at St. Louis, Mo. They weighed 50 tons each. The A. Wolf Iron & Metal Co. did the work with Oxweld apparatus

ceived in coils, and before being fed into the machine, seven or eight of these coils are welded together on a Toledo-Electric Welder Company's welding machine, which also removes the flash, and the metal is re-coiled into a large coil, weighing about 2,500 lb. The tubing is formed at the rate of from 3 to 10 ft. per minute, depending upon the size, and it is stated that the finished tubing comes from the machine within 0.003 to 0.004 in. of correct size, and that it is cut to length within an accuracy of 1-32 in.

The welding machines are built in double independent units and one or both units may be in operation at the same time. There are nine of these machines having a total capacity of 75,000 ft. of tubing per day. The machines are identical except that they have rolls of different sizes for forming the tubing in the range of sizes, it not being found practical to have sets of rolls of different sizes for use on one machine. From the main gas supply lines that enter the building oxygen is carried in a 1-in. line and acetylene in a 2-in. line over the machines. From these overhead lines the torches are supplied by ⅜-in. line. Individual electrical drive is provided for the welding machines by General Electric alternating current 440-volt motors, some of these motors being 5 and some 10 hp. A 3-ton Pawling & Harnischfeger electric crane with a runway across the building in front of the machines is provided for handling the strip steel.

The plant equipment includes Williams, White & Company bulldozers and Ferracute and Consolidated presses for bending, broaching, flattening and other fabricating work in connection with the tubing to meet commercial demands.

The company's oxygen plant is of unusual interest as it represents the most modern practice in arrangement of a plant of this character, is designed for large production and is provided with a new type of electrolytic oxygen and hydrogen generator. As hydrogen is not required in the manufacturing processes this is a by-product with the company and is sold to other users.

The oxygen and hydrogen plant which is located about 150 ft. from the main factory building is equipped with two type L bipolar filter press electrolytic oxygen and hydrogen generators furnished by the International Oxygen Company. These are the first generators of this design built. A third generator of the same type and capacity is being installed. The advantage claimed for the bipolar generator is a much greater capacity and smaller space and with less current, a single generator having, it is claimed, a production capacity equivalent to 50 unit cells and using one-sixth as much floor space, making the installation of generators of this type desirable where a large production is required and floor space is limited. Each generator occupies a floor space 15 by 5 ft. and is 8 ft. high. The type L generator installed, the larger of two sizes made, requires a direct current of 2 volts for each plate, and each machine, having 60 plates, requires 320 amp. at 120 volts. When operating at about 50 deg. C with 28.9 per cent potassium hydrate solution, the machine, it is stated, will produce at least 150 cu. ft. of oxygen and 300 cu. ft. of hydrogen per hour and 4 cu. ft. of oxygen and 8 cu. ft. of hydrogen per kilowatt-hour. This means a daily capacity of 3,600 cu. ft. of oxygen and 7,200 cu. ft. of hydrogen. It is stated that the purity of the gases direct from the generator averages 99.6 per cent for the oxygen and 99.8 per cent for the hydrogen, so that a purifying medium is not required.

Oxygen and hydrogen are carried from the generators through a 2½-in. line to two gas holders of 15,000-cu. ft. capacity just outside the building where the gases are kept under a pressure of 3 in. of water. The gas holders are 43 ft. diameter and approximately 26 ft. high, the bells being 40 ft. diameter and 13 ft. high. The holders were erected by the Cruse-Kemper Company, Ambler, Pa. The oxygen passes through an American Metal Company meter on the way to the holder. The hydrogen is not metered as it always is double the amount of the oxygen.

Electrical current for the generators is supplied by a General Electric 100-kw. direct-current generator set, the switches being so arranged that one generator can be operated singly or the two in series.

For charging cylinders with gas for use outside the plant there are installed in the generating room two air compressors. One of these is a Platt Iron Works three stage machine for charging oxygen, having a capacity of 12 cu. ft. per min. up to 2,000-lb. pressure. For charging cylinders with hydrogen there is a Norwalk Iron Works compressor capable of delivering 15 cu. ft. of gas per min. at 2,000-lb. pressure. There are two charging lines for charging cylinders, one for oxygen and the other for hydrogen. These each have a capacity of six cylinders at a time.

The oxygen supply for the factory is pumped from the large oxygen holder to two storage tanks on the opposite side of the generator building by means of a two-stage compressor furnished by the Hall Steam Pump Company, Pittsburgh, Pa., and capable of delivering 400 cu. ft. per min. at 300 lb. pressure. These tanks have a capacity of 5,000 cu. ft. each at 300 lb. pressure. Automatic electrical control is provided to stop the pump when the pressure on the tank reaches 300 lb. and to start it when the pressure drops to 275 lb. In usual practice gas is being used from one tank while the other is being filled, but both tanks can be filled same time. The gas is carried from the high pressure stor- at the same time and gas can be taken from both at the age tank to the factory in a 2-in. underground line, the pressure being reduced to 50 lb. by a reducing valve at the tanks. The storage tanks are 20 ft. high and 4 ft. diameter. They were built by the John Wood Mfg. Company, Conshohocken, Pa. Acetylene is delivered to the factory building in a 2-in. underground line from the carbide plant located some distance away.

The main factory building is a steel frame and brick structure 381 ft. long and 110 ft. wide, to which an extension 117 by 71 ft. is now being erected for steel storage purposes. It is divided into three bays with a monitor bay in the center. The roof trusses are spaced 16 ft. on centers, but the building columns are spaced 32 ft. apart, every other center column being eliminated by carrying the center and side trusses on trusses on longitudinal girders. The end of building in which the welding machines are located is built in the form longitudinal girders. The end of the building in which the welding machines are located is built in the form of a and provide a runway under the trusses for the crane that of a transept in order to have the trusses erected cross-ways serves the machines. Another reason for the transept is that it can be extended to join with a parallel building when the growth of the business warrants the erection of another unit. The roof trusses rest on 30-in. brick pilasters, between which the sides of the building are of glass in Fenestra steel sash. The sash in the side walls is 12 ft. high and there is a continuous sash in the monitor 7 ft. high. The side walls are of common brick and the front is of selected common brick with stone trimming. The roof is of flat concrete slabs 2 ft. wide and 5 ft. long, the purlins carrying the slabs being 5 ft. apart. The roof slabs are covered with tar and gravel roofing. The floor is built of 5 in. concrete slabs over which is laid 3-in. creosoted wood block flooring furnished by the Ohio Wood Preserving Company, Pittsburgh, Pa. Convenient toilet room facilities are provided on a mezzanine floor located in the roof trusses. The front of the factory building is a two-story structure used for office purposes. The oxygen and hydrogen generator building is 43 by 66½ ft., the acetylene building is 21 by 35 ft., and in addition there is a boiler house for heating purposes 36 by 28 ft. These smaller buildings are of brick and steel construction. The plant was designed by Ernest McGeorge, engineer, Cleveland, Ohio.

LARGE STERN WHEEL SHAFT WELDED WITH THERMIT

Repair Executed on Steamship "Captain Weber" of the California Transportation Company

Our San Francisco branch was recently called upon to repair the stern wheel shaft of this steamer at Stockton, Cal. The "Captain Weber" is a vessel of 690 gross tons; is 174½ feet long, 36½ feet beam and 8 feet depth. The average diameter of the shaft was 11½ inches. This shaft was cracked at the base of the fillet at the face of the first flange hub on the port side (high pressure engine side). The crack extended about two-thirds around the shaft and was of unknown depth. It was decided that the best way to make the repair was to weld the shaft to the hub, the shaft being of hammered iron and the hub of case steel. This plan had been previously followed in June, 1906, when we welded the shaft of the steamer "J. D. Peters" for the California Navigation and Improvement Company at the direction of Mr. James Burns, port engineer for that company. This repair proved to be so successful that Mr. Burns decided to follow the same methods in repairing the "Captain Weber". In the case of the "J. D. Peters", however, the wax process was not in use and the weld was made by using dry sand cores made to fit and then heating the bare metal of the shaft. At that time it took 1½ hours from the time the torches were withdrawn before the mold was ready for the Thermit steel and of course a great deal of the effect of the preheating was lost.

In this repair the wax process was used. The space between the face of the hub and the cylinder was only 10¾ inches and most of this space was used for the two eccentrics operating the valves of the high pressure engine. By reducing the width of the eccentrics it was possible to create a space of 2¾ inches from the face of the hub that would not be covered by the eccentrics. Two and one-half inches of this space was utilized for the Thermit steel band which extended 2½ inches on the hub and 2½ inches on the shaft and was, therefore, of a total width of 5 inches and 22⅛ inches outside diameter.

It would have been rather difficult to shape the wax in place because of the restricted space in which the work had to be done and also on account of not being able to turn the shaft, which would have necessitated the shaping and supporting of the wax on the bottom half of the shaft. To avoid these difficulties a wooden pattern of the wax ring was made and molded and from this the wax ring was cast in two halves. This provision saved a great deal of time and also possessed the advantage of allowing the venting of the wax ring without difficulty, by simply cutting out a groove which communicated with the gates and riser.

It goes without saying that the shaft and flange hub had been very carefully calipered beforehand so that the wax ring was a perfect fit and this enabled the operators to set the wax and complete all the molding in one day's time. The lower half of the wax ring was supported in place by a band of muslin, which proved to be a very neat arrangement, and protected the surface of the wax while ramming underneath in the very contracted space in which it was necessary to work.

An iron mold box had been provided using the iron wheel disks for the box on one side and separate iron sheets for the other side of the box. The upper half of the box was connected to the lower half by two straps, which at the same time formed the abutment for the ends of the box. These ends were also made bottom and top, leaving a space for the preheating core between. There were two end pieces provided as backing plates so as to permit the tamping of a retaining wall of sand after the heating had been completed to guard against a runout. The end pieces of the box were not connected with the side pieces in any way by bolts or otherwise. The above-mentioned straps formed the abutment on the outboard end of the box and angle irons formed t abutment on the inboard end at the wheel disks.

After the caps had been removed from the bearings and t shaft stripped of its eccentrics on each side, the wheel a the shaft were raised 11⅝ inches. This was done by inse ing heavy timbers through the wheel and blocking the spok of the wheel in the form of an arch between these timbe

It should also be mentioned that the preheating was do through two opposite holes located at the horizontal dia eter of the shaft and a separate run-off below was left f the wax. This little run-off was very useful and saved th wax passing off in volume and soaking into the sand of th mold. On account of the perfect venting of the wax started to run out almost immediately at the beginning the preheating and about two-thirds of the wax was saved this way. The wax ring contained 31 lbs. of wax altogeth of which 21 lbs. was saved.

Another point worthy of special mention was the pr heating, which was started on the morning of June 7t This heating was done through a hole in the mold taperin from 3 inches to 2 inches and flaming burners were used o each side of the shaft instead of the ordinary straight piece of burner pipe. These flaming burners of the regular Gold schmidt type worked very well after they were once ho and the nipple inserted about 1 inch into the torch hol Two preheating tanks were used and 10½ gallons of gaso line were consumed in each 5¾ hours, making approximately two gallons per hour each. The heating was in progress from 10 o'clock in the morning until 3:40 in the afternoo At 3:20 the forward burner was removed so as to permit o inserting the backing plate and ramming with black san to prevent a runout at that point. The forward slag run-of was also set in position at that time. At 3:38 the after burner was removed and directed into the riser. Shortly afterwards, while the after preheating hole was being plugged up and the sand rammed in between the box and backing plate, the slag run-off was also fixed to the after end of the box. At 3:48 the torch was removed from the riser and a 3:59 the Thermit charge was ignited. The crucibles were bolted and chained to the wheel spokes with asbestos and iron sheets to protect these as well as possible. These sheets were carried to the top of the fantail roof in order to guard this from catching fire. Two No. 9 automatic crucibles were used and each was filled with 275 lbs. of Railroad Thermit and 13¾ lbs. of additional punchings. The action in the crucibles was rather violent, owing to their not having been used before, but they were tapped in 37 seconds and it took an additional 30 seconds for the crucibles to empty.

There was a little difficulty in igniting the charge in each crucible on account of the height of the top of the crucibles above the shaft. A heavy plank was arranged at a sufficient height to enable two men to do the lighting of the two crucibles at the same time. This plank, however, was in the way of tapping the crucibles and it was therefore arranged to have one man on each end of the plank and the moment the Thermit charge was ignited and the operators had jumped from the plank, these two men then threw the plank overboard as had been prearranged.

With reference to fire protection, the roof of the fantail suffered no damage whatever, but 4 or 5 wheel spokes were rather badly damaged and had to be renewed. This was expected, and in fact the removal of all the wheel spokes before the beginning of the job was discussed, but it was finally decided to allow them to remain in place with a view of only replacing those that might be damaged. There were only 5 damaged out of 20 and a considerable saving was effected by not removing 15 wheel spokes, braces and other parts. It was unanimously decided that if in similar repairs the question should come up whether to remove the spokes to prevent them from burning, it would be best to allow them to remain on account of the difficulty which would otherwise ensue in raising the wheel. The spokes formed

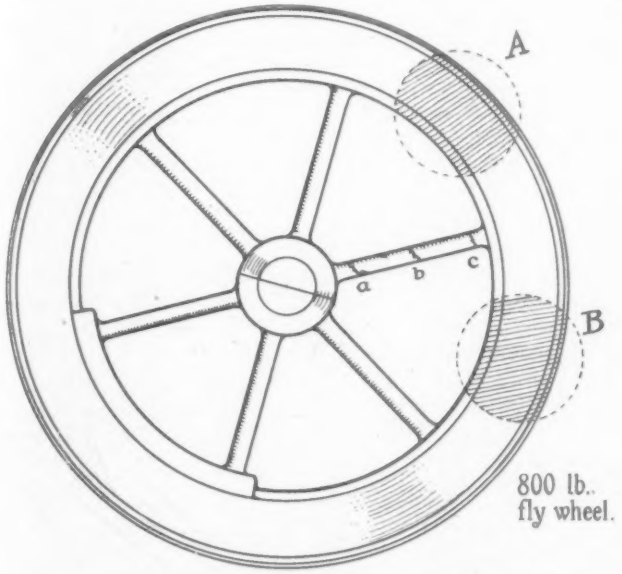
the abutment for the blocks arranged in the shape of an arch between the timbers, above mentioned, inserted in the wheel, and if the spokes were removed they would have to be replaced in order to properly raise and support the wheel.

The presence of the spokes, of course, means constant vigilance in avoiding fire and the use of a water hose for such a purpose would wet and cool the shaft very close to the mold. To avoid this the shaft should be covered with an iron sheet for three or four feet inside of the wheel.

The work was carried out under the direction of Mr. L. Heynemann, manager of the Pacific Coast branch of the Goldschmidt Thermit Company.—From Reactions.

PREHEATING A LARGE FLY WHEEL

The article, which appeared in the January issue of The Welding Engineer relating to the welding of spokes on fly-wheels, etc., has brought forth an interesting communication and sketch from Mr. I. Jackson, Fortier, Manitoba, Canada. His letter reads as follows:



Spoke in this flywheel was broken in three places

"One spoke in this 800 pound fly-wheel was entirely broken out, being in three pieces in fact.

"A welding was first made at B, as shown in the illustration, the welding being leveled on each side, of course, to save filler and fuel. A preheating fire was built under rim at A and B, and while A and B was still hot, the two remaining welds were made at A and C on the spoke.

"I have had great success with fractured and broken spokes by preheating the segment adjoining. It is impossible to keep all parts of the spoke being welded as cool as necessary; or in other words, it is impossible to keep the heat from separating the weld."

VANADIUM STEEL FOR OXY-ACETYLENE WELDING

Within the past two years, vanadium steel has been coming into more and more extensive use for oxy-actylene welding purposes.

Interesting reports as to results secured from its use in this application have recently been received from two manufacturers of welding equipment and supplies.

In each case the results were highly satisfactory.

About a year ago, the Bierman-Everett Foundry Company, Irvington, N. J., purchased some vanadium steel welding wire for trial purposes from L. L. Driggs & Co., New York eastern representatives of the United Steel Company.

This trial lot was used to repair the chassis frame of a large motor truck, vanadium steel being resorted to in this case in order to secure a stronger weld.

The wire acted very well under the torch flame, running freely. For a flux, the foundry company used their crucible steel compound.

Following this trial, several of the above company's customers purchased lots of vanadium steel wire for welding purposes.

Record was kept of the results with a view to obtaining further data as to its possiblities in this application.

The conclusions reached from this investigation are best stated in a letter on the subject just received from Mr. Berlenbach, secretary of the Bierman-Everett Foundry Company, from which we quote:

"Your letter of the 5th inst. received, and in reply we beg to advise that we have been purchasing vanadium steel wire for oxy-actylene welding in increasing quantites, and we now include this wire in our stock as a staple article. Inquiries among our customers show that they are having good luck with vanadium steel wire and are well satisfied with same. The best recommendation we can give is the fact that we are now receiving repeat orders for this wire from parties who have tried same."

Similarly satisfactory results of vanadium steel in this application are reported by the Economy Welding Machine Company, Kansas City, Mo.

Last May this company purchased a supply of one-fourth inch vanadium steel bars from the Carnegie Steel Company.

The kind of vanadium steel used was what is known in the steel maker's classification as type "F". This contains no chromium. The chemical composition of the heat from which the above order was made was as follows:

Carbon	0.10 %
Manganese	0.24 %
Vanadium	0.17 %
Phosphorus	0.012%
Sulphur	0.028%
Silicon	0.214%

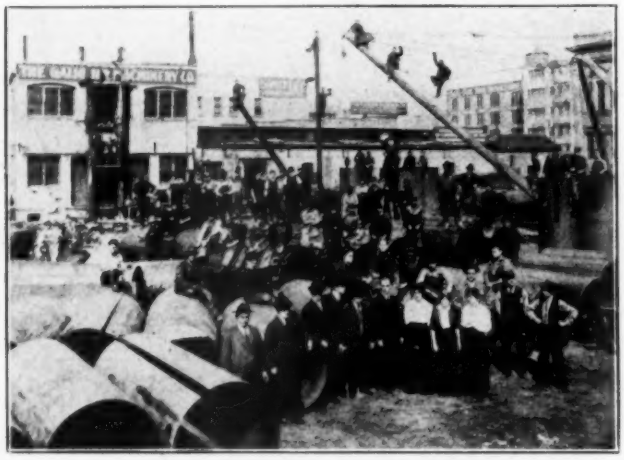
It worked well under the torch; and as a result of this first order, they have purchased a second supply of the same steel from the above makers.—From American Vanadium Facts for February.

STEEPLE JACKS USE CUTTING TORCHES

Oxy-acetylene cutting torches have come to be a part of the necessary equipment of Steeple Jacks. An interesting piece of work which is being done at the present time by Reynolds & Belleus, Room 601, 542 South Dearborn Street, Chicago, is the dismantling of a huge smokestack at the plant of the McAvoy Brewing Company, Chicago, Illinois. This stack rises to a height of 180 feet above the engine house, and is six feet at the bottom, tapering to five feet at the top. The stack is brick-lined and the operators are cutting from the inside, beginning at the top. This is an ordinary constructed stack, consisting of six foot lengths, each length being in two pieces, riveted at the sides, seams being staggered. An iron ladder runs up the outside of the stack, which makes the work a very simple problem for the Steeple Jacks. The brick lining at the top was removed and a small staging was put in place inside of the stack, resting on the brick lining, which after being torn out formed a perfect pier. The six foot section immediately above the staging was cut away and lowered. Through the apertures in the staging the brick lining for the next six feet was then knocked away, the staging, of course, being carefully lowered during this operation. This work was done during the very cold weather, but the workmen said that because of the fact they were working inside of the stack, they did not find the work unpleasant. It was estimated that with two men working on this job they would be able to dismantle the stack in about five or six days. A feature of the work is the fact that the stack has been cut away in such a manner as not to destroy its usefulness; and it is said that the wreckers have already sold it for erection at a plant where its size will be suitable.

WELDING FITTER PRESSES

An interesting question on Oxy-Acetylene welding is being handled by the Galligher Machinery Company, of Salt Lake City, Utah. The illustration shows a section of the yard of the Galligher Machinery Company, and in the foreground will be noticed large steel plates or shells. These shells are made from ⅜ inch steel, are 4 feet in diameter, and are 10 feet long. The open seam shown in the illustration is welded, and the head which is applied in one end of the shells is also welded. These shells when complete with



Plant of the Galligher Machinery Co., Salt Lake City.

the dashed head in one end and a cast iron cover on the other end make up a part of the equipment for the Kelley filter press, which is used in sugar factories for the filtration of sugar liquor. In the last two years over three hundred of these presses have been made in the plant of the Galligher Company and shipped to various parts of the world. It is said that in all cases these shells have been welded, both as to seam and the head, and in no case has there been a failure of the welding to stand a working pressure of 60 pounds to the square inch. These presses are all subjected to a hydraulic test of 125 pounds per square inch before being shipped. Other types of the same press up to 8 feet in diameter, 14 feet long, made of one-half inch steel, have been turned out without any trouble. About ten men are kept busy in the welding department constantly and the equipment of the Davis-Bournonville Company is used.

METAL AUTO WHEELS WELDED

At the recent Chicago Automobile Show the Hydraulic Pressed Steel Company, of Cleveland, exhibited the New Parker-Hydraulic Pressed Steel Wheels, which were interesting to the welding trade. This is a wheel which is suitable for use on light cars, which is made the proper size to fit on the ordinary Ford hub, but which also may be fitted on to any other hub with flanges up to six and one-half inches. The wheel will take an ordinary one-piece clincher rim, and will fit almost any of the transversely split, quick detachable, clincher rims. These wheels are made from two pieces of steel plate, a front half and a back half, which are welded together by the Oxy-Acetylene process. In appearance they very closely resemble the ordinary artillery wooden wheel. Their distinguishing feature is the entire elimination of the felloe and felloe band. There is a bolt, nut and clip for each end, and this adjustment takes care of the mounting of rims. This arrangement is made possible by a system of electric spot welding. These wheels are said to be lighter and greatly add to car mileage.

THE THOMSON OR RESISTANCE PROCESS OF ELECTRIC WELDING AS APPLIED TO THE WELDING OF HIGH SPEED STEELS

By F. S. Stearns.

As the Thomson process of electric welding, or the resistance method as it is otherwise called, has been well known and extensively used for the past quarter century, we need not take up space here for describing its general application.

It has recently come about that this most convenient process could be utilized for the conserving of the high speed steels, due especially to the abnormal cost of Ferro-Tungsten, which goes largely to make up the alloy known as high speed steel.

The present handling of all classes of metal work demands new and better tools accompanied by enlarged output.

A great impetus was given by the discovery of the capacity conferred by Ferro-Tungsten in the making of steels for cutting purposes, as this alloy would stand up to its work much longer and under higher speeds than any other steel.

Everyone knows the great revolution in working metals brought about by the use of high speed steels in cutting tools or implements.

Manufacturers have recently felt the necessity of finding some method permitting a smaller supply to do the same amount of work.

They naturally turned to the uniting of this steel, by the electric welding process, to cold rolled, machine steel, or common tool steel.

We will here endeavor to show the practicability of electric welding high speed steels to low grade steels for the manufacture of all forms of tools for lathes, shapers, planers, drill presses and numerous other appliances.

The increased cost of these special steels alluded to affects such steels as are known in the trade as Novo, Dreadnaught, Blue Chip, Regular High Speed Steel, Special High Speed Steel, XX High Grade High Speed Steel, Red Cut, Ark, Ketos and Mohawk High Speed Steel.

These steels, before the scarcity of Ferro-Tungsten was felt, sold for much less than $1 per pound, and today they are costing over $3 per pound.

With this high cost, the making of tools of solid bars was felt by all manufacturers to be almost prohibitive. They were the first to realize that some method must be found to use up all pieces down to the smallest, and to do this would mean the joining of these pieces, by some practical method, to larger pieces of lower grades or cheaper steels.

All other known methods of joining these steels have been tried, and while some few pieces have been made useful, the larger percentage of such attempts have been found so defective as to be impracticable. With the electric weld properly made, there is nothing to prevent that part of the tool which carries the cutting edge, and that part only being made of this high speed steel, even at the present cost.

It is proposed in this article to point out a few examples taken from actual practice; such as drills, taps, reamers, side tools, etc.

Users of these tools do not in general realize how many of the drills which they use are already constructed by taking advantage of the electric welding method.

The fluted or cutting part of a drill may be made of high speed steel and the shank of a special tool steel developed especially for that purpose.

One large manufacturer of drills, who also is a manufacturer of steels, spent considerable effort in developing this special steel and is now using it in the manufacture of his own drills; also selling it to other manufacturers of drills for their use. This steel is made up of an alloy that welds to high speed steel perfectly by the process of electric welding alluded to above.

It has been found that an enormous saving can be made by welding high speed steel blades to common tool steel reamer

shanks for both hand and machine reaming; also by welding forged high speed steel tips to forged tool steel, plain bars of rolled tool steel, machinery steel, or cold rolled steel holders for planer, shaper or lathe tools.

One of the largest manufacturers of valves, who makes most of his own taps, states that in one of his branch factories only, there are used four hundred (400) one-half inch (½-inch) pipe taps per year, and the saving on these four hundred (400) pipe taps (using high speed steel at $2.75 per pound) is $1,272 per year on this size only. The cost of these taps, if made of solid high speed steel bars, would be $1,940, a very high cost indeed when it is considered that these taps are 100 per cent perfect in the welding, due to careful selection of proper material for welding. This gives some idea of the saving which can be obtained.

While it is practicable to weld such materials known as Novo, Dreadnaught, Blue Chip, Regular High Speed Steel, Special High Speed Steel, XX High Grade High Speed Steel, Red Cut, Ark, Ketos and Mohawk High Speed Steel, as well as other high speed steels, the best results are to be obtained only by a careful selection of the lower grade steels to go with them.

This, of course, means that certain lower grade steels weld best to certain grades of high speed steels.

In making welds in all cases, like conditions must be observed for each and every weld, and the low grade steel must be very uniform in its composition.

Welding of this kind requires an experienced operator; a man who understands that great care must be taken in the welding together of different metals and that much depends upon the treatment of such welds after the welding is done.

Upon this treatment depends largely the life or length of time of successful operation of the tool. Special treatment has been given these welds after they are made, but having studied the subject, the Thomson Electric Welding Company, Lynn, Mass., has developed a special method of handling this work which gives it the right to say that by such methods one can expect practically perfect work.

To sum up, the conditions for success are expert men doing the welding, a careful selection of stock and special treatment before the welds are machined for use.

All tools made in this way must be machined after welding, as there is metal extruded at the weld which in most cases it is desirable to remove.

The same welding machines can be used in the saving of high speed steel by brazing (in special cases) the high speed steel and low grade steel together, instead of welding. For instance, this process may be applied if it is desired to set a piece of high speed steel into a recess on the end of a bar of low grade steel and, at the same time, it is not desired to do any finishing or removing of metal after it is made. In this method the heat can be confined to any desired point or portion of the work.

It will be seen from the above that the electric welding of expensive high speed steels to lower grade steel supports is a special development requiring skill in manipulation and knowledge of the properties of the materials used. In this respect, it differs from ordinary electric welds of low grade steels, which are very easily made without particular or unusual skill.

In spite of this limitation, however, there is no special difficulty in carrying out the process with success, and under present conditions it gives promise of a very wide application, accompanied by a great saving to the metal working industry.

Mr. Karl L. Brackett, president and general manager, Metal Weld Company, San Francisco, passed through Chicago February 16, on his way East. This company is agent for Davis-Bournoville apparatus in San Francisco.

THE OXY-ACETYLENE WELDER

He stands in the middle of Hell an' grins,
Where a salamander would choke,
His hide is constructed of elephant skins,
The throat of the brute is as black as black,
An' his lungs are a similar shade
An' he hasn't a shirt to his sweating back
When he's sweltering at his trade.

Eatin' the smoke,
Eatin' the smoke,
Eatin' the smoke with vim,
Sometimes I kick
At my own hard trick,
But I wouldn't trade jobs with him.

Where the preheating torches snort an' roar,
Or the charcoal fires burn,
Or out on the big break-down job
He has his living to earn,
An' all he does is to play with fire
The whole of the working day,
An' breathe hot smoke to his heart's desire
As long as he draws his pay.

Eatin' the smoke,
Eatin' the smoke,
Watchin' the hot metal glare,
You wouldn't pine for a job like mine,
But it's better than that one there.

He tramps around in Asbestos dust,
In a sort of inferno scene,
With cutting torch sputtering fit to burst,
An' molten steel that's green,
Steel that's green, and blue, and red,
As it boils when the gas whoops through,
An' big sparks flying above his head
With drippin's of molten stew.

Eatin' the smoke,
Eatin' the smoke,
His goggles are foggy and dim,
An' both gloves are burned,
As his pay is earned,
But I wouldn't trade jobs with him.

An' added to this is the fret an' fears
Of the story the cooling will tell,
An' he's listening hard with both his ears
For the snap of the busted weld.
An' will it stand the rack and strain
When it's shrinking back to size,
Or will he have to weld it again,
As he mops the sweat from his eyes.

Eatin' the smoke,
Eatin' the smoke,
The flames have blistered his face,
He's singed his hair,
But he don't care,
For it's held, and he's won the race.

(Apologies to a Poet.)

Gas Weld Rail Bonding For Electric Railways

By J. ROWLAND BROWN,
Electrical Engineer, the Ohio Brass Company, Mansfield, Ohio.

On electric railways it is necessary to make an efficient electrical connection between the lengths of rail at the joints and one of the best methods, put into extensive use in the last year, is that in which a stranded copper bond is welded to the rail by the oxy-acetylene flame.

Rail bonds have been welded to rails by the use of the oxy-

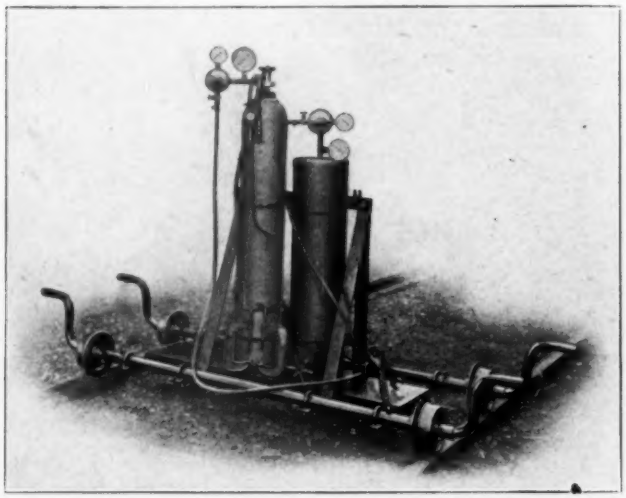


Fig. 1.—Complete outfit mounted on suitable truck.

acetylene flame for years, but only recently have the obstacles to the general use of the process been removed. These obstacles consisted in the lack of an easily procurable supply of pure gases at a reasonable price and of readily portable tanks; in the use of torches not adapted to the particular job; and of copper wire, with its great power of absorbing gases when melted, for the welding material; and in the absence of a properly designed bond. These obstacles have now been

Fig. 2.—A welder at work installing a bond.

overcome and the accompanying views show the complete outfit mounted on a suitable truck (Fig. 1) and a welder at work installing a bond (Fig. 2).

As it is necessary for two men to be able to lift the complete outfit off the track to permit cars to pass, it is customary to use a 100 cubic foot tank of oxygen and a 100 cubic foot tank of dissolved acetylene.

The tip used on the welding torch is one consuming approximately at the rate of 30 cubic feet of each gas per hour with the regulators set at about 12 pounds pressure for acetylene and 15 pounds pressure for oxygen.

The proper design of bond for use with this process has only recently received the necessary consideration. In the first place, the weld should be made either to the head or the base of the rail. On account of the intense heat of the flame it is necessary to have a sufficient body of copper in the terminal to conduct the heat and to prevent burning or melting

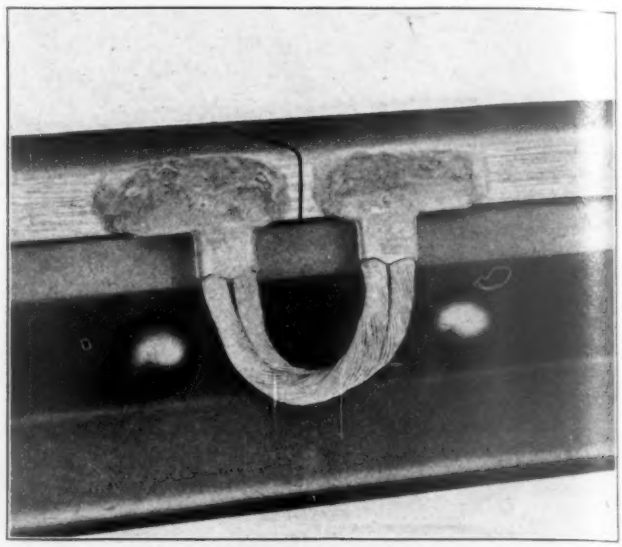


Fig. 3.—A welding wire is built up on top of the initial terminal, forming a new tapered bond terminal.

away of the terminal while the rail is being brought to the welding point. It is impracticable to weld the rail and the surface of the original terminal, which is adjacent to it, because the surfaces cannot be properly heated to the weld-

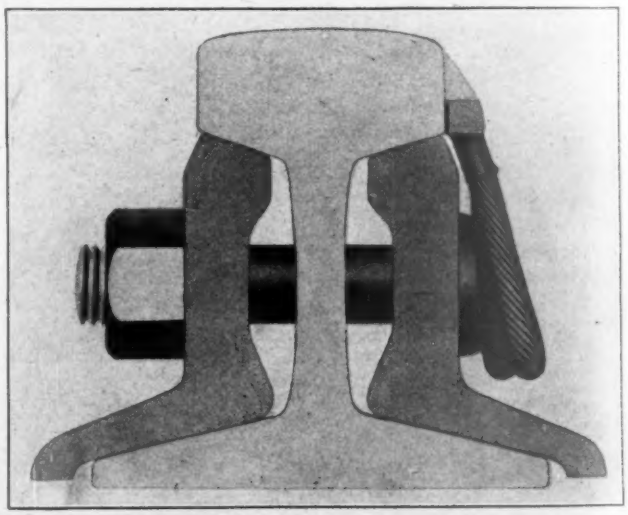


Fig. 4.—The bond now has a tapered terminal which prevents traffic from exerting a destructive shearing action.

ing point. Therefore the welding wire is built up on top of the initial terminal, forming a new tapered bond terminal. This is clearly shown in accompanying views (Fig. 3 and 4) (patented). The bond now has a tapered terminal which prevents traffic from exerting a destructive shearing action, but causes all wheels or other destructive forces to glance off. Another feature of design is the provision of means for keeping the initial terminal about one-sixteenth inch away from the rail to allow the gases of the flame to escape and not form a pocket when welding into the corner. The cable or ribbons of the flexible portion of the bond must also be protected for a sufficient distance by a sleeve to prevent burning by the flame.

Until recently annealed copper wire has been used for the welding wire or filling-in material, but as copper oxidizes and absorbs gases rapidly when melted it is impossible to produce even a fairly non-porous structure for the built-on part of the terminal with pure copper. A flux wire of non-oxidizing alloy containing a high percentage of copper has, therefore, been developed. This produces a more perfect weld, free from porous spots, and is much easier to manipulate than copper.

It is not necessary to prepare the surface of the rail for the weld, and on exposed rail, one end of the bond is clamped in position while the other end is being welded, and then the clamp is removed and the second end is welded. In bonding in paved streets one or two paving blocks are removed and the bond is located by embedding the strand in some loose sand without a clamp. The operator first coats the surface of the rail with flux metal, as by this method it is easy to see, from the manner in which the metal spreads over the

Fig. 5.—An etched section of welded portion of rail. The dark area adjacent to the welded surface shows that welding has changed structure of steel.

rail, whether or not the oxide has been burned off. The flux metal is then built in between this coating and the initial bond terminal, producing the beveled terminal shown in the accompanying figures. A little practice will enable an average track man to control the flame and make a good weld by this method.

The connection between the terminal and the rail is very strong mechanically and will resist the shearing strains produced by traffic. In fact, it is impossible to tear the terminal from the rail contact and failure only occurs by fracture through the copper structure. The electrical resistance of the terminal contact is approximately 2.5 microhms, which is slightly more than has been attained by other terminals. This difference is due to the resistivity of the flux metal forming the terminal, which is greater than that of pure copper. This difference, however, is negligible and, as there is no depreciation of the contact, it is electrically very efficient.

During welding the terminals of the bond are heated to a bright red and sometimes the strand becomes a dull red for a short distance from the sleeve. This heating does not injure the bond in any way, as the mass of cold metal in the rail acts as a chill and anneals the copper. A series of vibration tests, comparing new bonds with welded bonds that had been cut from the rail, showed that in no case did the welded bonds break down before the unwelded ones.

A study of the effect of heat on the structure of the steel rail has proved very interesting, and after very careful tests and investigations it can be safely stated that the welding process does not have any detrimental effect. An etched section of the welded portion of a rail is shown in Fig. 5. The dark area adjacent the welded surface shows that the welding has changed the structure of the steel to a depth of three-eighths inch. The affected zone does not extend longitudinally beyond the welded terminal of the bond. Another illustration (Fig. 6) shows a microphotograph of the etched section on the dividing line between the fine structure produced by the welding process and the normal structure of the rail. On the lower side of the line the normal structure consists of large pearlitic areas and patches of ferrite characteristic of open-hearth steel. On the upper side of the line the grain is finer, showing a fine pearlitic structure, which is the average structure of the area affected by the welding process. Scleroscope readings for hardness checked by tests with a Brinnell machine show the affected areas to be slightly harder than the rest of the rail.

The investigation showed that the areas affected and having a fine pearlitic structure have been heated to the critical point and were rapidly cooled by the mass of surrounding cold metal. The welding had refined the structure for three-eighths inch from the corner and had increased the hardness, but it had not seriously affected the steel. It is inconceivable that it could have affected the wearing properties of the rail or cause fractures or flaking.

The oxygen and acetylene consumed per bond cost approximately 10 cents, which cost varies with the distance to gas-

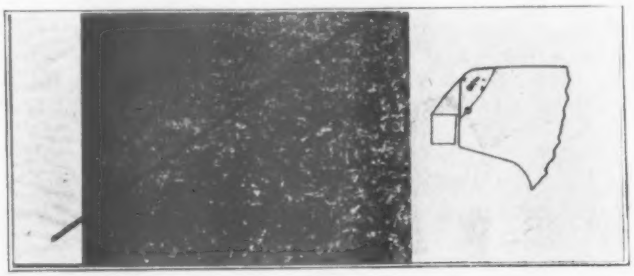


Fig. 6.—Microphotograph of the etched section on the dividing line between the fine structure produced by the welding process and the normal structure of the rail.

charging stations. The flux wire used per bond will cost approximately 8 cents, the price varying with the copper market. The cost of labor will average 4½ cents per bond. A gang of two men should average ten to twelve bonds per hour on straight work under average traffic conditions. An average cost of installation, exclusive of cost of bond but including depreciation and interest on investment, is 23 cents per bond.

The advantages of this process of welding are as follows:

The investment in apparatus is small, resulting in low interest and depreciation charges. The utility of the apparatus in shop repair work makes it a 365-day-in-the-year machine. The entire equipment is compact and easy to handle and does not necessitate interference with traffic. No electric current is required, a matter of considerable importance in construction work and in alternating current or high-voltage direct current installations. The welded contact has a high electrical efficiency and is permanent. The bonded joint is moderate in cost and easily inspected. When a length of rail is to be replaced one end of the bond can be cut loose from the old rail and rewelded to the new rail, thus saving the bond.

Questions and Answers—Correspondence

The Welding Engineer is very glad to hear from the trade concerning problems to be solved or unique welding work which has been done. We shall be very glad to hear from those readers who disagree with or have further light to throw on the solution of problems in this department.—Editor.

Editor, the Welding Engineer.

Dear Sir: I note on page 21 of the January number of your magazine an article on welding a wheel. I have welded several wheels of this kind, both of steel and of cast iron and cast steel. I have found that any cast wheel must be preheated all over or at least half. In the case of steel or iron wheels, however, I have never had any difficulty in welding a spoke without preheating, using a welding rod of pure drawn iron. This material in the weld has enough tensile strength to take the strain of the expanding and contracting when heating and cooling. I do not understand the article on malleable iron as in the large plant where I am employed; malleable iron seems to have nothing whatever to do with wrought iron or welding iron.

JOHN M. SABIN.

Chicago, January 28th.

Answer

You are correct in the matter of welding a wheel without preheating. That is all right in the case of a pressed wheel, but the spokes should be preheated to save oxygen and gas and heating the adjacent spokes will undoubtedly take away some of the strain and prevent distortion. Cast iron and steel wheels have to be preheated first to prevent cracking and incidentally to save gas.

See the article on malleable iron in February issue. The information contained therein comes from authoritative sources. The great trouble with welders is that they class all castings which re-act oddly to the flame as malleable castings. The writer investigated several cases of reported malleable welding and found that the article was made of cast iron or steel.

Editor, the Welding Engineer.

Dear Sir: What degree of heat is necessary to preheat an aluminum crank case with a long crack to be welded? Would you advise using a flux and drawn rod or cast rod?

CHARLES H. KNIGHT.

Chicago, Ill.

Answer

Practical welders tell the degree of preheating on an aluminum case by spitting on it as on a sad iron. If the bubble runs off spluttering, it is between 500 and 600 degrees Fahrenheit. At 700 small bubbles appear on the surface of the metal. At 1200 it melts. Support case carefully to avoid warping and watch fire carefully to avoid overheating.

There are many fluxes on the market for aluminum. Some welders use none on castings. It must be used on sheet aluminum. Either cast or drawn rod can be used. All use cast at present. There is no drawn on the market. Fluxes and rods should be bought of the most reliable jobbers to get the right mixtures.

Editor The Welding Engineer.

Dear Sir: In your No. 1 First Volume of your periodical you show method of welding high speed steel to tool steel. This is interesting dope and we desire to try this out. You mention in the fourth paragraph that "each is specially prepared by having a coating of special iron laid on the surface to be joined.

Will you please inform us what tinner is used?

Your magazine will be a source of great information and profit to the average welder if the numbers to follow are to contain information similar to the first number.

Please send your list of books on welding.

BOOMER AUTO CO.
By Geo. H. Boomer.

Wallace, Idaho.

Answer

The coating material is merely a Norway welding wire, although the new pure iron wire on the market is slightly better. It may be obtained from any reputable jobber. Mention The Welding Engineer. We aim to make successive numbers more interesting and want our subscribers to contribute their questions and experiences.

Editor The Welding Engineer.

Dear Sir: (1) State the correct method of welding a broken shaft or rear axle of an automobile. That is, would you heat it red-hot before starting, also about what per cent of carbon steel would you use in making the weld?

(2) What is about the average amount of oxygen used per foot of acetylene—that is, in welding iron or steel? My experience has been about one-half foot of oxygen per foot of acetylene.

M. McQUAIG.

Chicago, Ill.

Answers

(1) The rear axle of an automobile should be preheated but not to the red color. Most rear axles are of a medium carbon steel and will weld with either a Norway iron or up to 12 point steel welding rod. If the break or wear is on the square end of a driving shaft a 30 point carbon steel or nickel steel may be used, but care should be taken to burn out as little carbon as possible. In other words take the flame away as soon as possible. Preheating in this case is only for the purpose of saving gas and oxygen and not to prevent cracking. Use dependable supplies.

(2) There are three kinds of torches—high, low and medium pressure torches. Each manufacturer gives only the trade using their type of apparatus information calculated to solve trouble arising through improper methods. What have you? If you will tell us the manufacturer we will give you the proportions which should be used in your torch.

Editor The Welding Engineer.

Dear Sir: Please advise us where we can secure advertising slides to be used in moving picture shows? Same must show a welding job.

THE IDEAL VULCANIZING CO.

Pontiac, Ill.

Answer

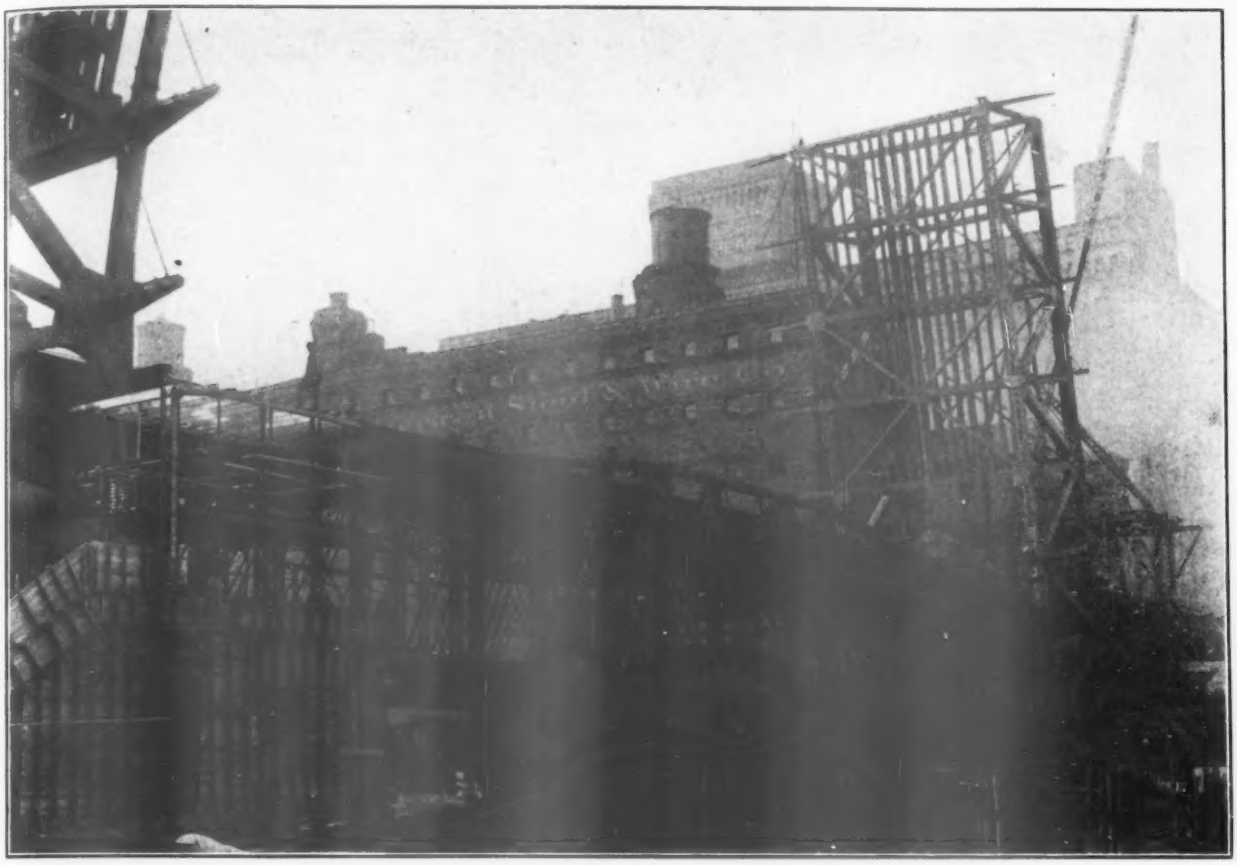
From the McIntosh Stereopticon Company, 30 East Randolph street, or Kansas City Slide Company, Kansas City, Mo. Furnish photograph of welding job and copy for reading matter to appear on slide.

Editor The Welding Engineer.

Dear Sir: Please send your list of books on welding.

CLARK O. WALSH

Hampton, Iowa.



To keep pace with the ever growing demands of traffic the old swinging bridge which spans the Chicago River at Lake Street is to be replaced by a modern "jack-knife" bridge.

Contractors—KETTLER-ELLIOTT ERECTING CO., CHICAGO

30 Minutes Time Allowed By the Authorities

To cut away the old drawbridge and drop the new "Jack-knife" Bridge in place. Oxy-Acetylene cutting made this engineering feat a possibility.

See descriptive article elsewhere in this journal on this work (as on many others) they chose to use.

TRADE COMMERCIAL STORED SUNLIGHT ACETYLENE MARK

Quality = *Guaranteed* = Quantity

Write US About Your Acetylene Supply

Commercial Acetylene Railway Light and Signal Co.

ATLANTA, GA.
AURORA, ILL.
BOSTON, MASS.
BOUND BROOK, N. J.

80 Broadway, New York City

PEOPLES GAS BUILDING
CHICAGO, ILLINOIS

EAST DEERFIELD, MASS.
TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

Answer

There are six or eight books on welding, and we are now corresponding with publisher to learn if they can be supplied. In the meantime we are able to furnish Kautny's Welding and Cutting at $1.00 and Hart's Welding at $2.50, and these two books are as good as any we know of.

Editor The Welding Engineer.

Dear Sir: We want a book on welding by the metallic arc process. If you have anything in print that covers this subject send it along C. O. D. We would like to get in touch with manufacturers of rods and fluxes, masks, electrode holders, etc. Have just received our first copy and are well pleased. HINER & REED.

Tillamook, Ore.

Answer

We know of no book devoted exclusively to electric welding processes, but will make inquiries. Advertisers in The Welding Engineer may be depended upon to carry supplies of all kinds.

Editor The Welding Engineer:

Dear Sir:—We have experienced some trouble with steel automobile springs. On some jobs we have fallen down, although the work was handled in the same manner as on jobs which were a success. How would you advise us to proceed? M. J. H.

Answer

The welding of automobile springs is a piece of work which should be handled very carefully. A common fault is the failure to retemper the springs, due generally to lack of proper equipment. It is impossible for a slug with ordinary equipment to retemper steel automobile springs and a preheating, annealing and tempering furnace should be a part of the shop's equipment. If the springs are preheated and retempered properly the work should be successful.

Editor The Welding Engineer:

Dear Sir:—I have installed a welding outfit in my shop and am getting along fine. I recently fell down on a small mowing machine part. I believe I am going to get considerable work from farmers, and would like to know where I can secure a book on welding farm machinery?

WILSON.

Answer

A great many parts found in farm machinery, particularly, reapers, binders, separators, drills, etc., are of malleable iron, instead of the ordinary cast iron. Before undertaking a job of this kind find out the nature of the metal. You will find elsewhere in this issue an article on malleable iron, written by a man who is very well informed on the subject. We have always believed that a method similar to brazing is preferable in the case of malleable parts, Tobin bronze filler rod being used. If you have an annealing furnace, however, this might not hold true, but remember that welding will destroy the annealing. An advantage in the use of Tobin bronze filler rod is the fact that it is very nearly as strong as steel and at the same time is soft enough to be machined easily. If you use cast iron or Norway iron filler rod the surface of the weld is sure to be quite hard. However, read the article in this issue above referred to.

Editor The Welding Engineer:

Dear Sir:—We have an oxy-acetylene outfit and have had good results in welding cast iron, brass, etc. But we have had some trouble in welding crack in boiler, as on several jobs after the weld was finished the crack would open up on account of expansion or contraction. We will thank you if you can give us some information on same.

HILL CITY MACHINE AND BOILER WORKS.

Vicksburg, Miss.

Answer

A successful welder recommends preheating around the crack in the form of an oval and also follows the plan of welding from each end of the crack, the seam meeting in the middle. Another welder follows the following plan:

Though no general rule can be laid down, it is usually necessary to remove a few rivets or stay bolts on each side of the crack in order to allow the metal to expand and contract during the welding operation. These can be replaced later. Where a patch is to be put in, use a round or oval patch in preference to square one, and either corrugate or belly the patch slightly, as this will give the metal a chance to contract without causing a new crack. Where a patch runs down to the mud ring of the boiler, let the portion at the mud ring be the last to be welded, so that there will be a chance for the metal to give during the entire welding operation. The metal should of course be beveled in the usual manner. Use Norway Iron filling rod of the best grade. This sort of work is rather difficult for the ordinary operator at first, because most of it has to be done in a vertical position, or even overhead, and the average operator is used to working in a horizontal position. Practice is the only thing that will bring skill. In training men in boiler welding we believe it necessary to let them weld on scrap boiler plate clamped in a vertical position, and then when the weld is finished, break it with a sledge hammer and examine the metal. The first welds made are usually of uncertain quality, but after a little practice any man who is a good welder on ordinary work can produce sound homogeneous welds in a vertical position just as well as he can in a horizontal position.

Editor The Welding Engineer:

Dear Sir:—I received my copy of The Welding Engineer and assure you that I was more than pleased with this first issue, which is certainly a neat and practical little paper. The articles are good and the class of advertisers is good.

The new processes of welding have certainly revolutionized many features of manufacture, and in my opinion it is the greatest development that has ever been effected along mechanical lines. Its benefits reach out to every branch of mechanics, whether they are the large manufacturing interests, the small manufacturers, the railroads, large or small machine shops or the repair shops in the small cities and villages. The different trades are closely related to one another, intermingled and dependent upon each other, so that which affects one favorably, also affects the other to a more or less degree. So that welding processes affect other branches of business.

The advancement, spread and growth of welding processes during the last few years has been almost beyond belief, and the interest and enthusiasm with which they have been received by all classes of mechanics is remarkable. It has now reached the village and country shops, and almost any town of importance is equipped with one or more Oxy-Acetylene plants, with more or less efficiency. The smaller class of shops as well as the larger institutions need The Welding Engineer very badly, and being one of the smaller class, I wish to say that all the different welding systems, electric, Oxy-Acetylene, Oxy-Hydrogen, Thermit, etc., are of great interest to me.

I realize, of course, that you must consider the interests of all users, and the advice and instruction which you will be able to give through such a paper as The Welding Engineer will be very valuable. The average welders must have plain mechanical advice, and instructions written in plain English, that can be read and understood by people who have only a common school education. The average mechanic is not usually fortunate enough to possess an education in algebra and geometry and instructions and formulas presented to him

United States Gauge Company

In future issues we will show gauges made standard by the various companies operating in the field of Oxy-Acetylene Welding

67 Wall Street, New York, N. Y.

Chicago—Detroit—San Francisco—Montreal

Factory, SELLERSVILLE, PA.

in algebraical and geometrical terms are about as useful as if written in the Chinese language.

However, I again wish to express my appreciation of your new publication, and assure you of my hearty support. I feel sure that the trade generally will appreciate your efforts, and lend its hearty support towards making your venture highly successful and satisfactory to the publishers—the trade and everyone concerned. R. E. HOY.

Covington, Okla.

THE TRUE VALUE OF THERMIT

By D. C. Lewis

In looking over the various issues of Reactions and noting the wonderful progress that has been made in recent years in the welding of heavy sections, I rather hesitate to prepare an article for publication myself. I feel, however, that perhaps everybody does not appreciate the progress that has been made, as repairs that were impossible a few years ago are so common now that they are passed by almost unnoticed.

Consider just a few years back in locomotive work. What did we do when an engine broke a frame or some other part? We would strip her and take the broken section to the blacksmith shop. What then? There was a man that drew the highest salary in the shop placed on the job, and I have seen as many as three blacksmiths weld one frame and so many helpers that they would fall over each other. I could give actual figures as to the cost of such repairs, but it is unnecessary to do this, as that is a thing that has passed and one that requires no monument to mark it. All we need to remind us of the old way of welding frames on locomotives or other similar sections is the Thermit crucible.

At one time I was in a certain shop that was always very much congested with broken frames, as the engines were handled very roughly and operated on a rough roadbed. The blacksmith shop employed a man who was paid 39 cents per hour and three helpers at 11 cents an hour, and this gang would work almost every night on frame welding, making the operation exceedingly costly. Things went on this way until they became enlightened one day by reading about the Thermit process. As time went by they began to use Thermit, and just a short while ago I was in the same shop and was astonished to see the change which had taken place. I asked the blacksmith foreman what had become of the large force he welded his engine frames with. He said, "Come with me and I will show you how we have improved the ugly old thing." I went with him to the erecting shop, and he said, "There it is." I will let the readers guess what he showed me, but it is what we all love around a locomotive repair shop.

I had the pleasure several months ago of visiting a number of different shops as well as several sawmills throughout the country, and I was astonished to see so many jobs taken care of by the Thermit process. Considering the class of labor very often employed, it struck me that a process that could be handled so satisfactorily by such men must be a very wonderful thing.

The Tar River Lumber Company at Rocky Mount, N. C., had two breaks in one of their engine frames which required two large welds. The general manager was at a loss to know just what to do, as this engine was the feeder for the mill and quite a large force of men was standing around doing nothing. He took the matter up with the private shops in the city and they reported nothing could be done by them. He then took the matter up with my shop superintendent, who gave instructions to look the situation over and see what could be done. I found that the broken frame was on a narrow-gauge engine, so of course it could not be brought to our shops, unless it were loaded on a car, and I therefore decided to make the weld by taking my materials and apparatus to the locomotive and making the repair there.

In doing this work I dropped the main wheels, jacked up the engine, cut the frame with a large hack-saw and made the two welds. The time lost by this engine was only two days, as it broke on a Friday morning and was again at work on Monday morning.

This engine was in a general rundown condition, having been worked exceedingly hard in order that all the timber possible could be hauled before the lease expired.

It had to operate over a very bad track on hills and valley, and it is not surprising, therefore, that the frame broke again. I welded the last two breaks and only kept the engine out of service one day. The first two welds cost the company from $45 to $50, including labor and material of all descriptions used.

About two weeks ago I met Mr. Groom, general manager of the lumber company, and he asked me if I was as good at anything else as I was on welding a frame, as he had some more work for me. I answered by telling him to give the credit to the Thermit process and the Goldschmidt Company, as without Thermit I could not have accomplished anything for him. I also recently made two welds on passenger engine No. 98 of the trailer type. This engine has a Thermit weld which has been giving service for ten years. The photograph, I am sorry to say, is not a good one, and I have fully decided that I can do better at welding than I can at taking photographs. We are continually using Thermit. I made two welds last week and have three broken frames in the shop at present to be welded. I am doing practically all our frame welding with Thermit. In fact, I have been welding frames with this process for several years, and I think I welded the first frame that was ever repaired by the Thermit process in this state. I am sorry I have not kept a record of the exact number of welds made, as I believe it would be of interest to the readers of Reactions.

In addition to frames, I have welded numerous other sections, such as guide yokes and equalizers, which are all giving valuable service to my company. Evidently the company appreciates the process and considers it a valuable asset or they would not continue to use it so extensively.—From Reactions.

RECORD OUTPUT OF TUNGSTEN ORE IN THE UNITED STATES IN 1915

The tungsten ore output of the United States in 1915 is placed by the United States Geological Survey at about 2,165 net tons of concentrates carrying 60 per cent of tungsten trioxide and valued at more than $2,000,000. This is a record output, the largest previous one being 1,821 tons in 1810.

While the price of ore late in 1914 was $9 or more per unit of contained tungsten, 60 per cent ore was sold as low as $5.80 per unit early in 1915. The price has since then steadily advanced until $50 and even as high as $62.50 per unit or more has been paid.

Early in the war England commandeered all the ore that was produced in any of the colonies, fixing a maximum price of 55s. per unit or about $13.50. American consumers since then have obtained ore from Mexico and South America. Portugal and Spain are also producers but they are controlled by British capital, says the Engineering and Mining Journal. Only recently have arrangements been made by which tungsten ore, contracted for in Portugal and Spain, may now be shipped, the first cargo of any size leaving for New York in December last. Japan shipped tungsten ore to this country when the price had reached $44 per unit and large amounts have been booked.

The bullets in a new shrapnel shell are welded to a wire, which, when the shell explodes, is thrown forward with a rapid whirling motion. The shell is apparently intended for breaking down wire entanglements.—Popular Mechanics.

Trade News

"Reactions" for the fourth quarter has been published by the Goldschmidt Thermit Company. As usual it is full of articles relating to important welding problems, which have been solved with Thermit. This issue is very highly illustrated, and in addition to some interesting articles relating to miscellaneous work, contains an interesting department devoted to Marine repairs. There is also a department covering work in railroad shops.

The Goldschmidt Thermit Company, 90 West Street, New York City, recently published a map calendar showing the United States, Canada and Mexico, which will be mailed to anybody upon request while the supply lasts.

The Department of Interior Bureau of Mines, Washington, D. C., has published Bulletin No. 100, entitled "Manufacture and Uses of Alloy Steels." This book contains some information that will interest the welder, and has to do with the treatment of alloy steels.

Two electric welding machines, built for the Saco Lowell Shops, Biddeford, Maine, will be of interest to the trade. These machines were built by the Toledo Electric Welder Company, Cincinnati, Ohio, and one of them is used in connection with the manufacture of shafting for spinning machines. This is a butt-type machine, while the other machine, of the spot-welding type, is intended for work too heavy to be otherwise handled conveniently.

A Chicago daily paper recently commented on the activity of motor factories in France, which have been enlarged for equipping the aerial fleet. A new motor of a special type is being used in large quantities. This motor is said to be very unique, one of the principal features being the use of copper water jackets. These jackets are autogenously welded to the steel cylinders by the oxy-acetylene process. Fifteen or twenty men are kept busy constantly in the welding department, which is supplied by its own generator system.

The Turner Brass Company, Sycamore, Ill., has issued a pamphlet descriptive of the No. 6 Turner Complete Welding Outfit and also the No. 6-A Turner Complete Welding and Cutting outfit.

Campbell & Rickel, of Minneapolis, have just published a little pamphlet describing Oxy-Acetylene welding equipment, supplies, prices, etc.

The Universal Welding & Cutting Company, 3800 Forest St., Racine, Wis., is the name of a new company which will engage in welding, cutting, etc.

Several concerns were represented at the recent Automobile Show in Chicago, among them being The Prest-O-Lite Company Inc., Indianapolis, Ind., Imperial Welding Company of Chicago, Lincoln Electric Company of Cleveland, Westinghouse Electric & Manufacturing Company of Pittsburgh, U. S. Gauge Company of New York City and the Turner Brass Company of Sycamore, Ill.

The Lincoln Electric Company, Cleveland, Ohio, have published a pamphlet on Electric Arc Welding. This pamphlet discusses the processes in general, and the principals of arc-welding practice. The equipment required is illustrated and described in the pamphlet, which is illustrated by photographs of actual work; a description also appears of the controlling apparatus.

An extensive aluminum smelter is being organized at Hoyanfjord, Norway, where there is a waterfall which may furnish 60,000 horse-power. It is proposed to develop 20,000 horse-power at once so as to produce 4,000 tons of aluminum per year. A number of beauxite beds have been secured in southern France, where the ore will be concentrated into oxides and shipped to Norway for conversion into metal by electric furnaces.

Aluminum production in 1915 in this country is estimated by several authorities at about 80,000,000 pounds, a record achievement, comparing with about 45,000,000 pounds in 1914.

The Maryland State Industrial Accident Commission has decided that a chronic ailment is no bar to the award of compensation even though the ailment contributed to the accident.

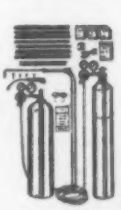
MELTING POINTS OF VARIOUS METAL

Tin	449° F.
Bismuth	507° F.
Lead	620° F.
Zinc	786° F.
Antimony	1169° F.
Aluminum	1214° F.
Bronze	1692° F.
Silver	1751° F.
Gold	1947° F.
Copper	1943° F.
Nickel	2600° F.
Cast Iron (White)	2075° F.
Cast Iron (Gray)	2228° F.
Steel	2532° F.
Steel, Hard	2687° F.
Platinum	2732° F.
Platinum	3110° F.

Tempering—Color of Steel

Faint Yellow	430° F.
Straw Color	460° F.
Dark Straw	470° F.
Purple	530° F.
Blue	550° F.
Full Blue	560° F.
Pale Blue	600° F.
Black Red visible in dark	752° F.

WELDING PHOTOGRAPHS
We make a SPECIALTY of photographing welding jobs
Chicago Architectural Photographing Co.
140 So. Dearborn Street Chicago, Illinois



GENERAL REPAIR SHOP
Oxy-Acetylene Welding Equipment
Complete With Gas Tanks Loaned $58.50
Campbell
ALSO WELDING SUPPLIES
801 Cass Ave., St. Louis

Solving the Riddle

THE Audit Bureau of Circulations solves the riddle of circulation for its members.

It places in their hands unprejudiced information on the various publications in which their advertising appropriations are being expended.

It tells how much there is, where it is and the kind it is.

"A. B. C. Service" is just as essential to the advertiser and advertising agent as Dun or Bradstreet's are to the credit man.

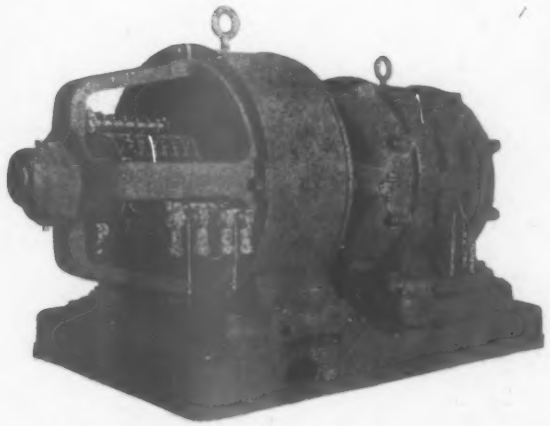
Why not back your judgment with solid facts?

The Audit Bureau of Circulations is a co-operative organization—not for profit—its membership includes over one thousand Advertisers, Advertising Agents and Publishers, in the United States and Canada, who believe in standardized circulation information. Complete information regarding the service and membership may be obtained by addressing—
Russell R. Whitman, Managing Director.

AUDIT BUREAU OF CIRCULATIONS
15 East Washington Street, Chicago

The Welding Engineer is an Applicant for Membership in the A. B. C.

The Best For You



ARC-WELDING MOTOR-GENERATOR SET ARRANGED TO SUPPLY SEVERAL OPERATORS SIMULTANEOUSLY AT DIFFERENT PLACES

When you install electric arc welding equipment to lower your welding repair costs, be sure to get the equipment that will best fulfill all your needs.

Remember:

The system which is most flexible is the one which will best do your work. You may want to use several operators and the full welding capacity on one rush job, or you may need considerable power on several jobs at the same time. You want power when you want it, where you want it, and at a minimum total cost.

A single delay due to lack of power **at the required place** is likely to cost you more than any saving you may be able to make by the use of smaller equipment.

Westinghouse Arc Welding Equipments are the most flexible and at the same time the simplest. The apparatus is of standard design and construction throughout. Hence this flexibility is obtained at low cost, for the equipment, the installation and the operative.

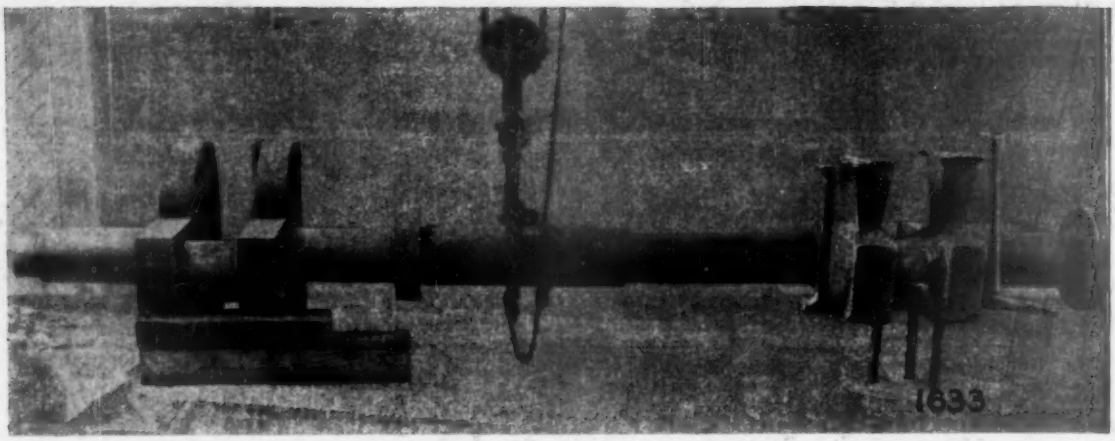
It'll pay you to investigate what other companies are doing.

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

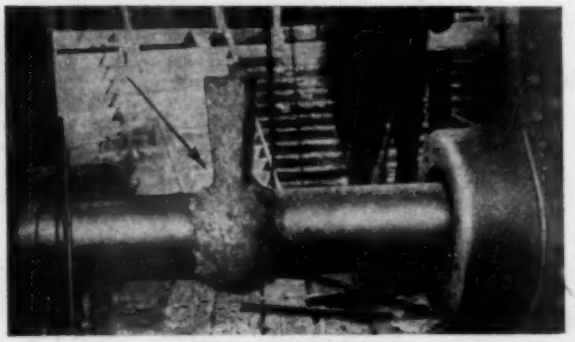
Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Bluefield, W. Va.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chicago, Ill.
Cincinnati, Ohio.
Cleveland, Ohio.
Columbus, Ohio.
*Dallas, Texas.
Dayton, Ohio.
Denver, Colo.
Detroit, Mich.
*El Paso, Tex.
*Houston, Tex.
Indianapolis, Ind.
Joplin, Mo.
Kansas City, Mo.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
New Orleans, La.
New York, N. Y.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Seattle, Wash.
Syracuse, N. Y.
Toledo, Ohio.
Washington, D. C.
*W. & E. Co., of Texas.

Say Welding—Think Westinghouse



Thermit Welds on 8½-in. Crankshaft. Two new webs and a crank pin were welded in one operation

Large Dredge Dipper welded with Thermit before trimming



11-in. Tail Shaft welded for steamship without removing it from vessel

The Thermit Welding Process Is the ONLY One That Will Give You a Permanent Repair on Wrought Iron and Steel Sections

WHAT THERMIT IS

Thermit is a mixture of granulated aluminum and iron oxide which, when ignited, reacts, producing superheated liquid steel at a temperature of 5400 degrees F.

HOW WELDS ARE MADE

A broken section is lined up and a mold built around the fracture. The fracture is brought to a red heat by a special preheater and the Thermit mixture is placed in a special crucible so that when the Thermit reaction is over, the liquid steel can be poured from the bottom of the crucible into the mold, and being at such a high temperature, is sufficiently hot to melt the sections with which it comes in contact and amalgamate with them to form a solid mass when cool.

Broken crank shafts, mine hoist shafts, gear wheels, fly wheels, dredge sections, engine frames, rock crusher shafts, and many other heavy sections, can be restored to service in one or two days at slight expense and often effect a saving of thousands of dollars in time and repair costs.

When you realize the advantages to be derived from use of Thermit for repairs you will install the process at once.

Write for Bulletin No. 1779

GOLDSCHMIDT THERMIT CO.

WILLIAM C. CUNTZ, General Manager

90 WEST STREET, NEW YORK

329-333 Folsom St., San Francisco 7300 So. Chicago Ave., Chicago
103 Richmond St., W., Toronto, Ont.

Crankshaft machined and ready for service. The arrow points to location of Thermit welds